

ROADS AND STREETS

APRIL 1946

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DRILL ROCK quicker, cheaper

with **TIMKEN**

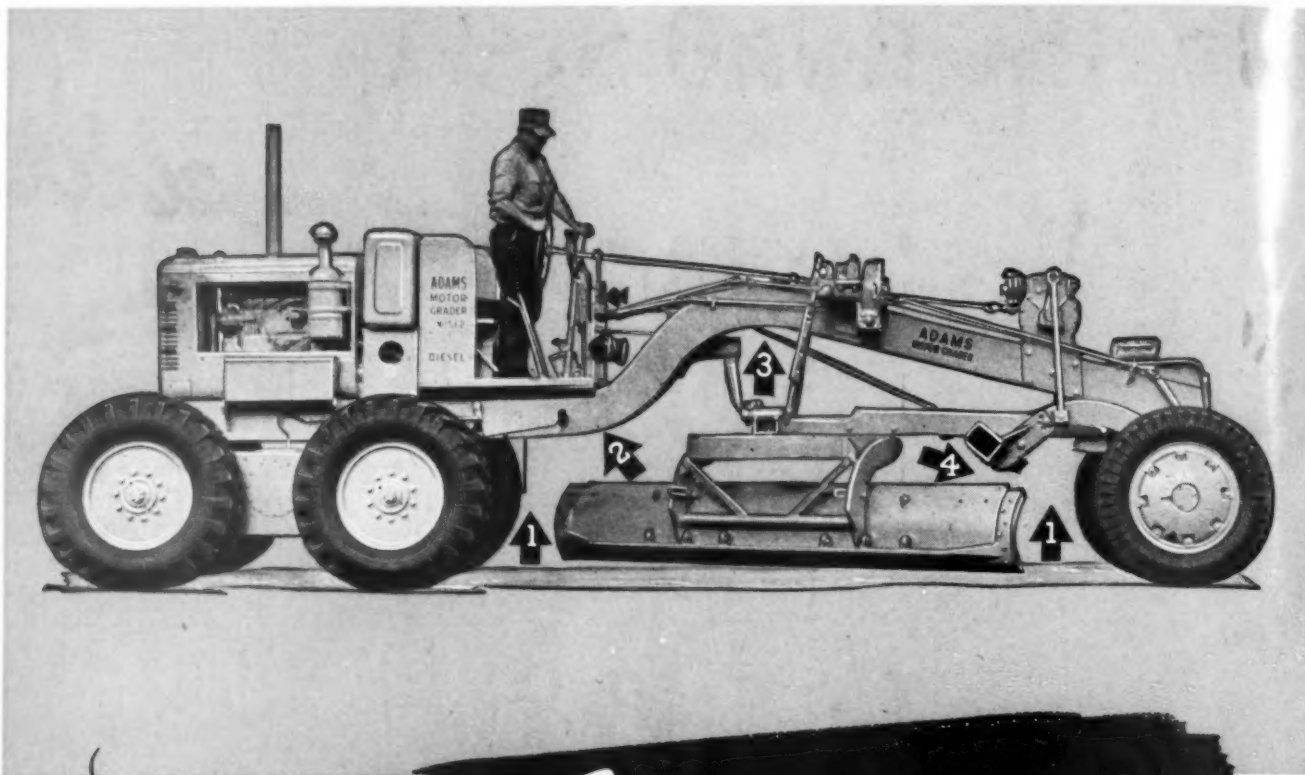
Rock Bits

Acclaimed by construction contractors and metal mine operators as the greatest rock drilling tool ever developed. An outstanding achievement of engineering experience; metallurgical knowledge; and steel making know-how; a highly specialized product manufactured in a completely-equipped modern plant where nothing else is made.

When we say that you can put down more holes in less time at lower cost with Timken Bits we are merely summarizing the experience of hundreds of contractors and mine operators who have standardized on these bits after proving their merits.

If you still are using conventional steels you don't know what you're losing; swing to Timken Bits and begin saving. Write for name of nearest Authorized Distributor. Look for the trade-mark "TIMKEN" on every bit you buy. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
ROCK BITS



Clearance

IN THE RIGHT PLACES
WITH ADAMS MOTOR GRADERS

● **BLADE CLEARANCE**—*plenty of it—in all operating positions . . . that's one of the important requisites for fast, efficient motor-grader performance—every day, on every job.*

You get plenty of blade clearance in Adams Motor Graders—because they're designed and built that way. Note particularly how Adams' advanced design provides plenty of "elbow" room for the blade at all critical points:

1. Between blade ends and tires—allowing ample room for sharp blade angles, without tire interference, front or rear.

2. Between blade and frame—permitting free movement of blade heel.

3. Between blade assembly and frame arch—providing space for higher blade lift and better ground clearances.

4. Between blade and scarifier block—allowing easy reversing of blade under the scarifier block.

These are but a few of the advanced features that make Adams Motor Graders your best bet for efficient, high-speed production. Ask your local Adams dealer for complete facts, or write company direct.
J. D. ADAMS MANUFACTURING CO., INDIANAPOLIS, IND.

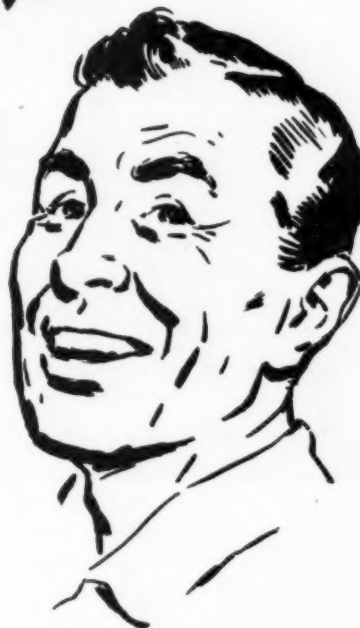


ADAMS

ROAD BUILDING AND
EARTH-MOVING EQUIPMENT

BUYING ROAD STEEL?

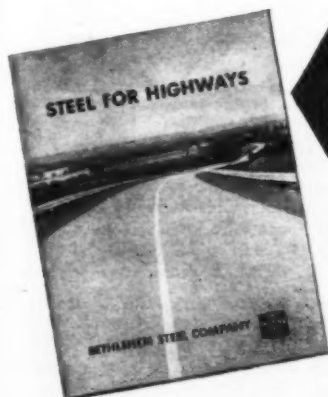
Get this "package" service from Bethlehem



It won't be tied up with ribbon—but you'll get all your road steel in one handy "package," if you place your order with Bethlehem. For we can supply every one of the steel products needed to build a concrete highway, or any kind of bridge.

Think what this means! By simply getting in touch with Bethlehem, you save time and money—save on bookkeeping, paper work, and shopping around for your needs. Your order is handled as a unit, with shipments scheduled to arrive on the job when and as you need them. No idle men or idle equipment, this way!

Add to these advantages the fact that the Bethlehem road steel line is rugged and sturdy—built for lasting performance—and you've really got something when you buy Bethlehem!



**NEW BETHLEHEM
HIGHWAY CATALOG**

SEND FOR YOUR COPY TODAY

Bethlehem's new illustrated catalog, "Steel for Highways," gives complete information about Bethlehem road-steel products. Send for a copy today. Ask for Catalog 191, and address the nearest Bethlehem district office, or Bethlehem Steel Company, Bethlehem, Pa.



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| ROAD JOINTS | DOWELS |
| DOWEL BAR SUPPORTS | CENTER STRIP |
| WIRE ROPE AND STRAND | |
| BAR MATS | BAR TIES |
| BEAM AND CABLE-TYPE GUARD RAILS | |
| HIGHWAY GUARD POSTS AND BRACKETS | |
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| PIPE | HOLLOW DRILL STEEL |
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PROFIT**

**FROM THESE 4 FEATURES
OF PERFECTION DESIGN**

The smooth and easy manner with which Perfection Hydraulic Hoists and Dump Bodies work together, quickly shows you the importance (profit to you) of

- 1 Double, compound-type lift arms
- 2 Lifting power applied nearest the center of the load
- 3 Lifting power distributed under full length and width of body
- 4 "Cushion-Stop" drop feature

These are just a few of the PERFECTION features which pay off in less wear and tear on the hoist and body and in more efficient operation and use of power.

Built for all makes and models of trucks. Write for bulletin and names of nearest distributors. . .



THE PERFECTION STEEL BODY COMPANY
GALION, OHIO

PERFECTION
TRUCK BODIES AND HOISTS

**ROADS AND
STREETS**

Vol. 89

APRIL, 1946

No. 4

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A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

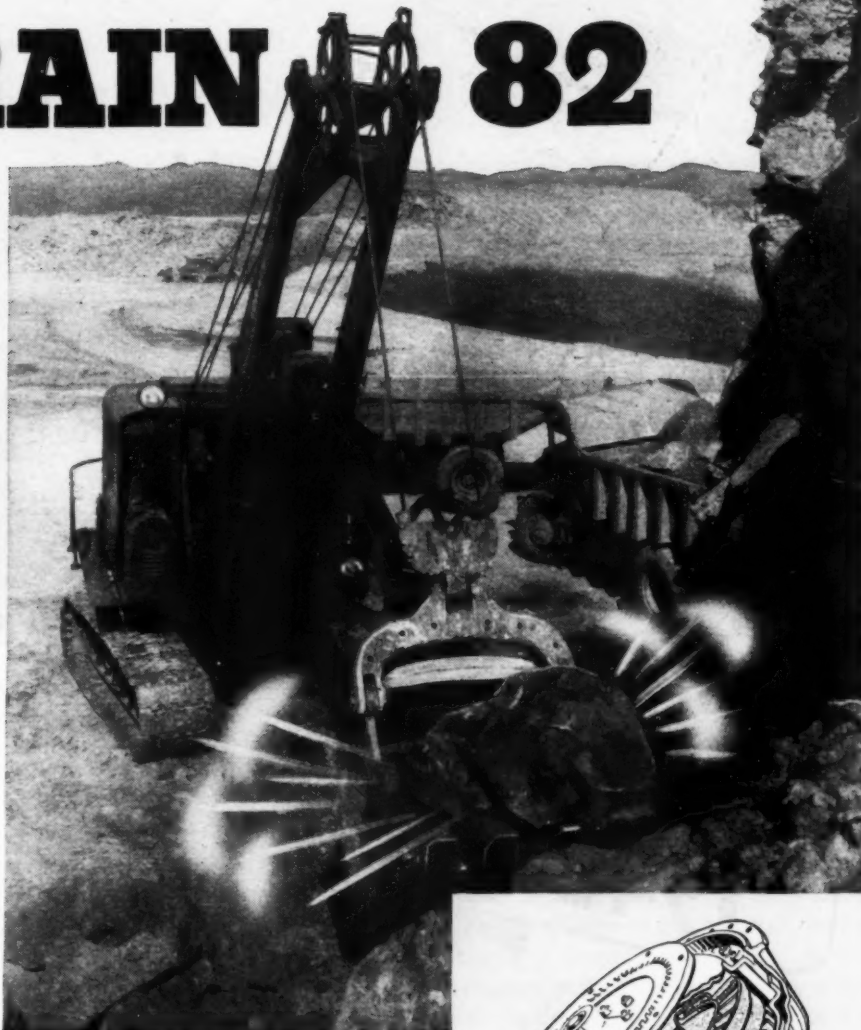
WITH ROADS AND STREETS HAVE BEEN COMBINED GOOD ROADS MAGAZINE AND ENGINEERING & CONTRACTING
HALBERT P. GILLETTE, President; EDWARD S. GILLETTE, Publisher; HAROLD J. McKEEVER, Editor; CHARLES T. MURRAY, Managing Editor; H. K. GLIDDEN, Eastern Editor (N. Y.); LT. COL. V. J. BROWN, Publishing Director (Absent on Military Duty); H. J. CONWAY, Advertising Editor; L. R. VICKERS, Promotional Director.

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When an "Irresistible" Force Meets an "Immovable" Object

A LORAIN 82

*"Rides
with the
Punch"*



When the big dipper at the end of a powerful 2-yd. Lorain-82 slams into a big boulder or rigid rock strata, something is going to give. Usually it's the rock, but the terrific impacts and shocks can be mighty unhealthy to a shovel and its "innards".

A Lorain-82 Rock Shovel is engineered throughout to take these beatings. What's more, it cleverly "rides with the punch"!

Why? Because a hydraulic coupling (see diagram) acts as a shock absorber to cushion blows and shocks, to protect the cables, boom and power mechanism. Lorain engines can't stall in rock or any

other digging! Their action is smooth as oil.

Your nearest Lorain distributor can explain the numerous mechanical advantages that insure the long life, low repair and maintenance cost, and the operating speeds which have made Lorains so predominant in brutal rock work.



The Lorain was first with the Hydraulic Coupling which not only delivers tremendous digging power, but provides defense mechanism to cushion and absorb return wallops and strains.

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THEW SHOVEL CO.
Lorain, Ohio

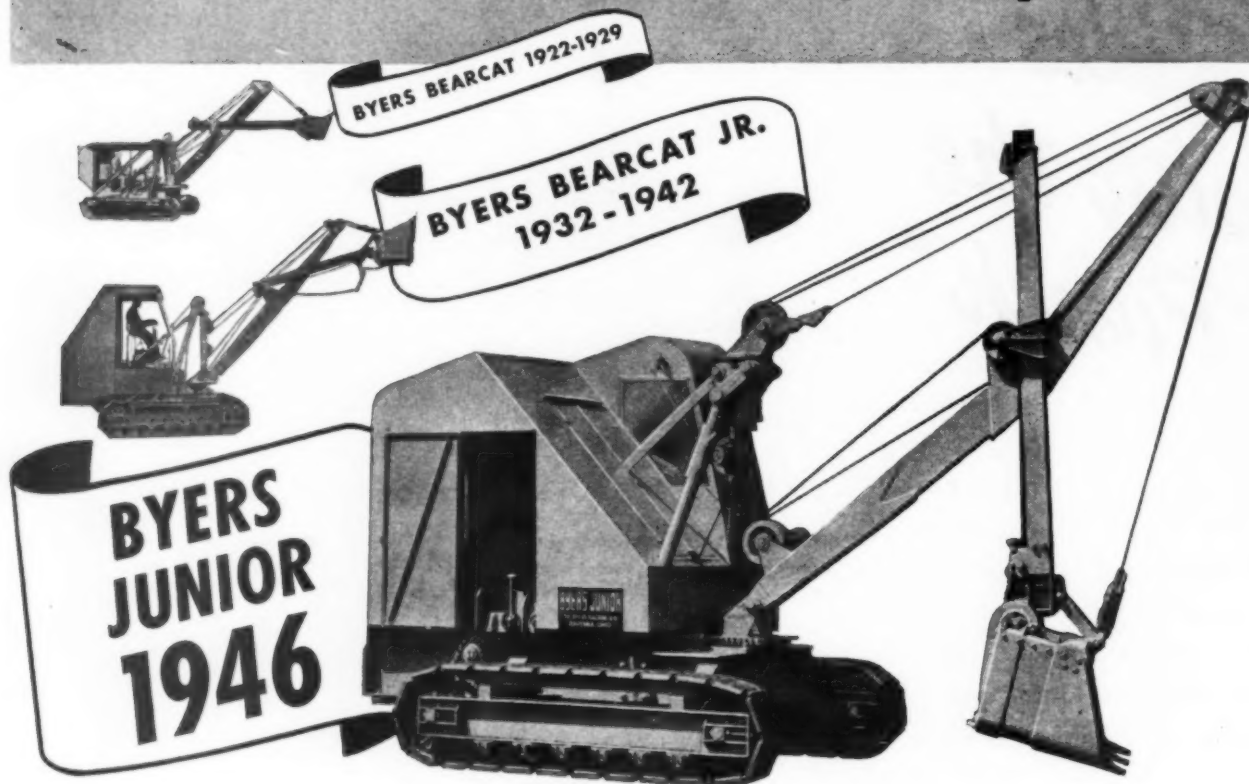
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THIRD GENERATION

of Byers Partial Swing Utility Shovels



For those plentiful excavating and material handling jobs of smaller size, you will want the new $\frac{3}{8}$ -yd. partial swing Byers "Junior" shown here.

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ECONOMY for state, county, township and municipal users.

PROFIT for contractors who need a sturdy $\frac{3}{8}$ -yd. shovel, crane, dragline or back hoe.

The Junior is not an old design modernized. All of Byers' many years of experience with the original Bearcat and the popular Bearcat Junior are embodied in a more rugged "super" design for this 1946 Junior that has been thoroughly tested, proved and approved.

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POWER-PACKED International Diesel TracTracs make short work of regrading and resurfacing country roads. These side roads, seldom seen by the motorist speeding through, are vital to the welfare of agricultural areas. They deserve the same, efficient road-building and maintenance consideration as do the major traffic arteries.

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International *full-Diesel* economy means that more work can be done per dollar of expenditure for fuel. International advanced-design features assure greater operating efficiency. International's exclusive instant

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Yes, the county and township and village roads deserve the advantages of International *full-Diesel* Power, too. In fact, if costs and performance are to be determining factors, International Tractors and Power Units will be the wise choice for all local as well as state highway jobs! The International Industrial Power Distributor near you can demonstrate the many "reasons why".

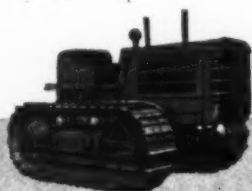
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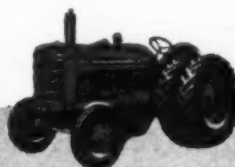
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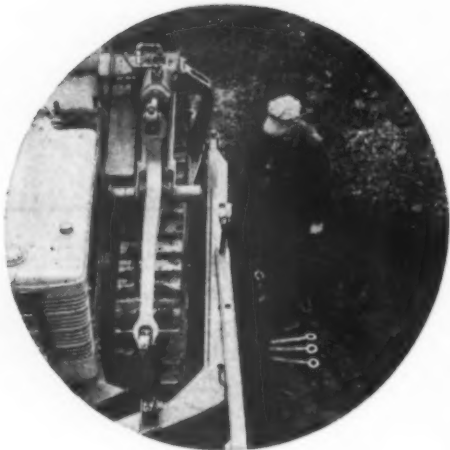
ANGLING



•• AND •• that the OPERATOR Will Use!

"Sure . . . a blade angling and tilting feature can be a big help on plenty of jobs . . . but I'll be darned if I'll bother to angle or tilt if it takes a half hour to do it! I want to move dirt!" The Speaker? Almost any blade equipment operator. It's no problem to get your operators to use the effective angling and tilting features of Bucyrus-Erie Bullgraders, because they're both so easy to do — fast. Without tools, the operator angles the blade by pulling the landside pins, adjusting the blade to the correct angle, and replacing the pins. To tilt, he uses a landside pin

TILTING



to hammer out the wedges that hold the blade in position, shifts the blade to the tilt he wants, hammers the wedges back in place. Neither angling nor tilting takes more than a couple of minutes!

Both you and your operators will like the many other features of the Bucyrus-Erie Bullgrader, too: its easy handling through smooth hydraulic control and balanced-to-the-tractor design, its powerful digging down pressure, its complete visibility, its ability to handle so many jobs efficiently. Ask your International TracTractor Distributor for complete details.

12745

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SEE YOUR INTERNATIONAL TRACTRACTOR DISTRIBUTOR

**AIR
PLUS**

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When You Can Get a Jaeger?**

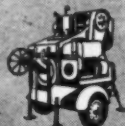
- Air-cooled, 2-stage vertical compressors built in a balanced "W" with larger valves, interchangeable precision parts, force feed lubricated.
- 20% to 30% slower, long-life piston speed, 100% efficient intercooling, automatic drainage.
- Big engines of latest type.
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Loaders



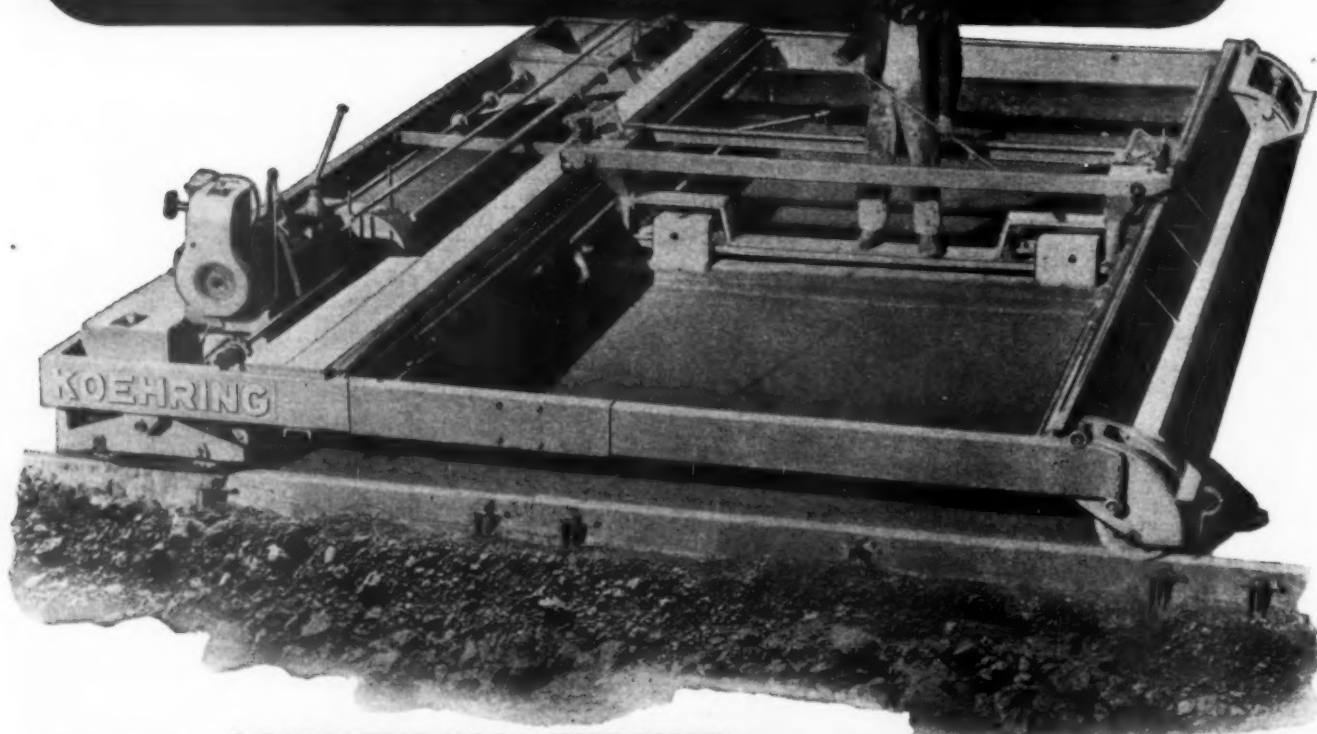
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Concrete Mixers



"SURE PRIME"
Contractors Pumps

JAEGER-LAKEWOOD SPREADERS, FINISHERS AND BITUMINOUS PAVERS, FORMS, FORM TAMPERS—"DUAL-MIX" TRUCK MIXERS, AGITATORS—JAEGER HOISTING ENGINES, TOWERS

IS OBSOLETE HAND BULL FLOATING HOLDING BACK YOUR PAVER?



KOEHRING LONGITUDINAL FINISHER KEEPS UP WITH ANY PAVER PACE

Can you afford to hold back your paver simply because the hand finishing crew can't keep up? When, with a Koehring Longitudinal Finisher on the job, you might be laying all the concrete your paver can produce? Yes, the Koehring Longitudinal Finisher keeps right up with any paver — and offers other important advantages as well.

FINISHES WHEN SURFACE IS READY

Only the Koehring Longitudinal Finisher can finish some surfaces at the exact time when finishing should occur—after

the surplus water has risen to the surface, when the concrete will no longer bleed after it has received its final finish. Hand bull floating often cannot touch harsh concrete at this stage.

EXACT COMPLIANCE WITH SPECIFICATIONS

Surfaces finished by the Koehring Longitudinal Finisher are smoother riding, wear better, because crowns are finished exactly as specified. Savings on finishing labor costs often run high.

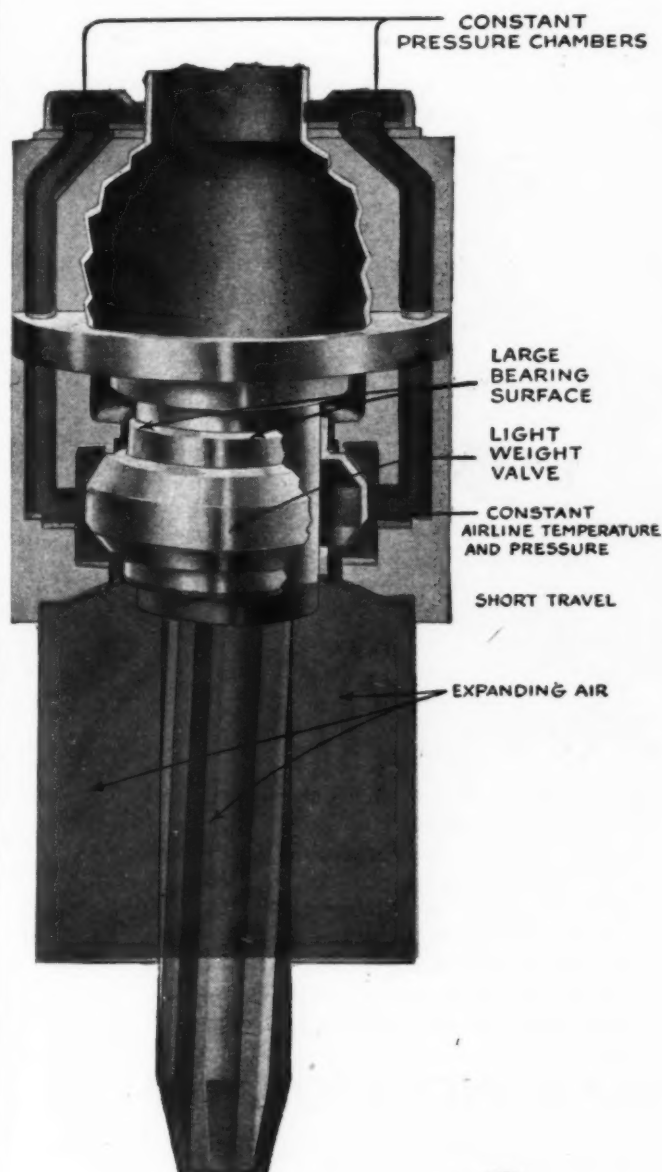
KOEHRING COMPANY • *Milwaukee 10, Wisconsin*

HEAVY-DUTY CONSTRUCTION EQUIPMENT



WHY LEADING CONTRACTORS SPECIFY *Thor*

ROCK DRILLS and BREAKERS



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*Thor's Light Weight, Short-Travel Valve
Produces More Work—Cuts Operating Costs!*

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NON-FREEZING . . . Never "Air-starved." Constant pressure chamber maintains air at constant line temperature and pressure. Air cannot expand until it passes valve . . . thus valve cannot "freeze."

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Wearers of the service emblem, you have proved to the world that Americans with American-made machines could not be defeated. Many of you have used LIMA cranes, shovels and draglines to build air strips and bridges; to load and unload ships; to remove debris from bombed areas and countless other jobs important in winning the war. You have seen the efficiency of LIMA machines under trying conditions, how their

smoothness of operation, ease of control and fast operating speeds step up the tempo of the job. To the veterans, who will continue to serve America in peacetime construction, LIMA offers the same high quality shovels, cranes and draglines which served so well in war. LIMA shovels are made in sizes ranging from $\frac{3}{4}$ yard to 5 yards capacity, crane sizes range from 13 tons to 100 tons. Write for bulletins.

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SHOVELS

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CRANES

13 Tons to 100 Tons

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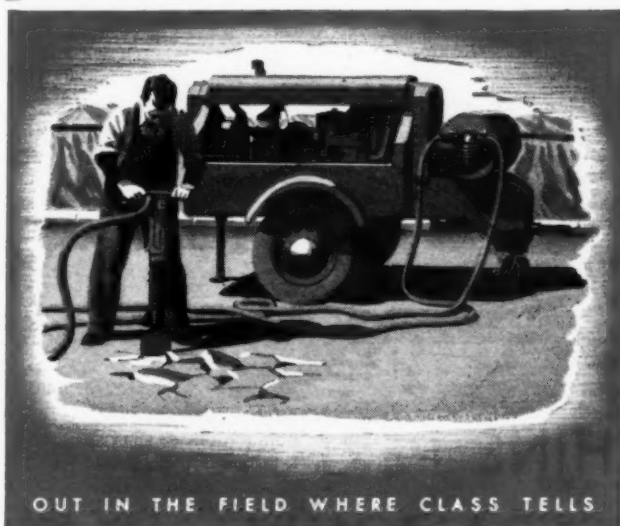
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21 Years of Engine Building Experience — The Background That Gives Character To Chrysler Industrial Engines

CONCEPTION*... Back in 1924, Chrysler introduced a new conception of the internal combustion engine — compact, high compression, flexible horsepower. Ten million Chrysler-built engines prove the value of this conception.

The basic principles incorporated in Chrysler Industrial Engines have resulted in the immediate approval and acceptance of these efficient, economical and portable power units by various manufacturers of industrial equipment.



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It is significant that, during the war, more than 250,000 Chrysler Industrial Engines furnished rugged, economical power for many types of equipment purchased by the government.

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*One of the 8 character points in the Chrysler Industrial Engine Pedigree

Low Cost Power For Road Builders

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Chrysler Industrial Engines, in practical application,


prove the fine qualities and character built into them through engineering research, superior design and the finest craftsmanship. Here is truly "Horsepower With A Pedigree".

Low cost is assured Chrysler Industrial Engine users — whether installed in air compressors, shovels, cranes, pumps or other applications in construction.

Attention Dealers: Some desirable Chrysler Industrial Engine territories are available. Write to the Chrysler Industrial Engine Division for complete information.

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Please send the Chrysler Industrial Engine Catalog.

Name

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RIGHT DOWN THE LINE

DITCHING

in Road Building
**ONE MACHINE PERFORMS
 ALL OPERATIONS!**

You can do more work, more KINDS of work, more of the time, with a Link-Belt Speeder "shovel-crane" because it is quickly, easily convertible to any earth moving or handling operation.

Look at the variety of jobs illustrated here, all connected with road building — all done with the same standard Link-Belt Speeder, with interchangeable front end attachments.

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For Prompt, Efficient, Convenient Sales and Service:
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Builders of the Most Complete Line of
SHOVELS-CRANES-DAGLINES
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AHEAD ★
ON GOOD ROADS!

TRAVEL WHERE YOU WILL... an HD-7 will cross your path



It's a country-wide hit! East Coast, West Coast, North and South . . . popular Allis-Chalmers Model HD-7 2-Cycle Diesel Tractor is in demand everywhere . . . by contractors, states, counties, townships, ranchers, loggers, miners, gravel and quarry pit operators . . . for a multitude of jobs! Just the right size for most bulldozing work, ideal for operating 2-wheel scrapers — provides 60 drawbar h.p., speeds to 5 m.p.h. . . it's easy on fuel, easy on maintenance cost, easy to maneuver. Starts instantly! Travel where you will . . . you will find the HD-7 keeping production up . . . costs down. It will pay you to get all the facts from your Allis-Chalmers dealer.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

Swing's the thing

IN A DRAGLINE

MARIONS

swing far . . . swing wide . . . but most important **SWING SMOOTHLY.**

- The smooth swing cycle of a MARION DRAGLINE adds extra yardage to every shift.

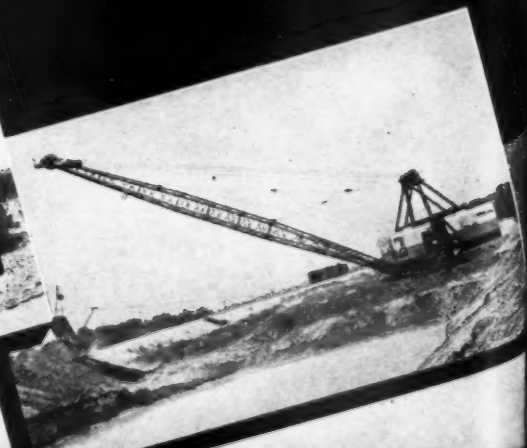
There is a MARION dragline to fit your job.

THE MARION STEAM SHOVEL CO.

MARION, OHIO, U. S. A.

$\frac{3}{4}$ cu. yd. to 40 cu. yds.

Offices and Warehouses in principal cities



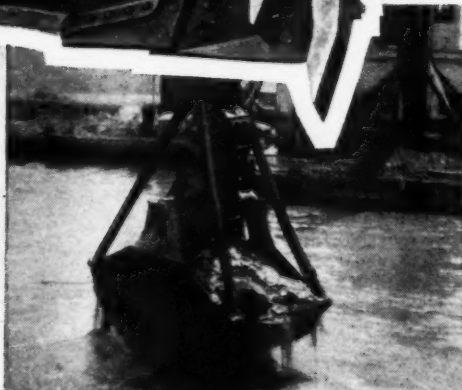
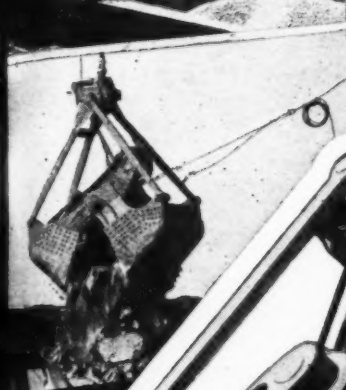
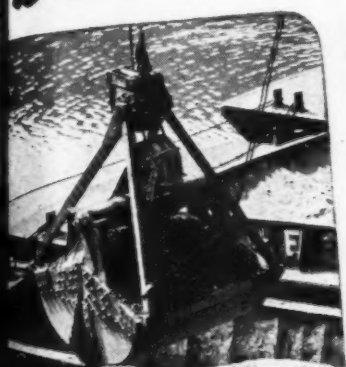
You always get BLUE RIBBON PERFORMANCE WITH **BLAW-KNOX** **BUCKETS**

Good bucket performance means less time out for repairs and maintenance — constant pay loads on all kinds of digging and rehandling work — full utilization of crane capacities.

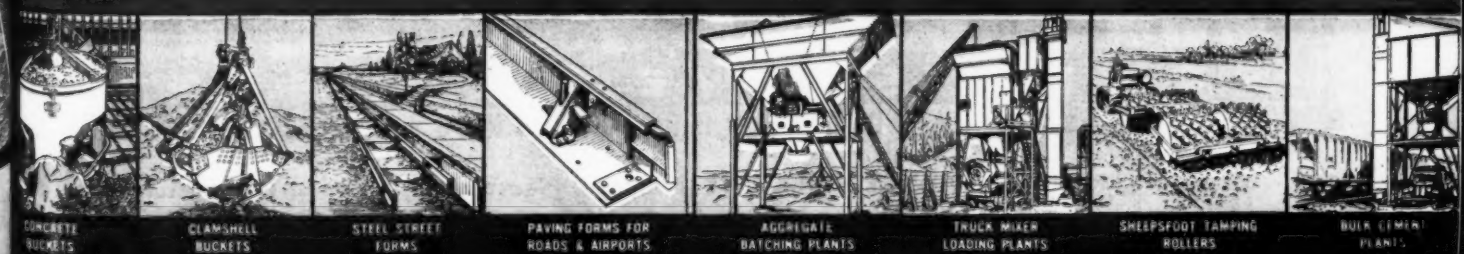
Catalog No. 1757 will show you how to select the exact bucket for your job. Send for it.

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now getting under way

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WITH REAL PROFIT EARNING EQUIPMENT
to successfully compete for
your share of this business?**

You'll need fast, rugged, economical-to-operate machines — like up-to-the-minute MICHIGAN Mobile SHOVELS-CRANES. They can be relied upon to stay on the job day after day with a minimum of maintenance or repair — they've proven it on scores of tough civilian and military jobs the world over . . .

IT WILL PAY YOU TO INVESTIGATE
these profit-earning advantages of
MICHIGAN Mobile SHOVELS-CRANES
— write today for data and speci-
fications in Bulletin RS-46.

★ WPB estimate for 1946

$\frac{3}{8}$ yard and $\frac{1}{2}$ yard
Shovels — convertible
to crane, clamshell,
dragline, trench-hoe.

6, 10 and 12 ton

CRANES

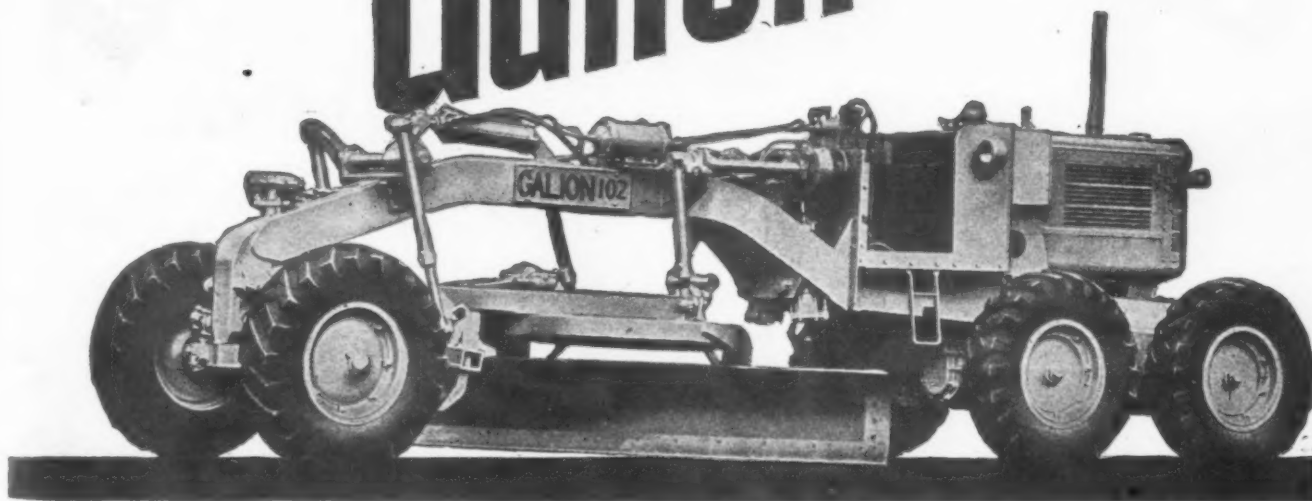
**FINGER TIP
AIR CONTROLS**

MICHIGAN

POWER SHOVEL COMPANY

BENTON HARBOR, MICHIGAN

The Galion 102



- Perhaps you haven't had a chance to see this new Galion motor grader yet . . . we are doing everything we can to speed up production. There should be one in your particular territory now . . . or right soon. Check with your nearest Galion Distributor . . . have him tell you about this motor grader and how it can help you do a better job of road, street and airport construction than ever before. Our rollers are also in great demand with nice weather in the offing . . . maybe you had better check on them, too. Be sure it's a Galion and be sure of meeting all your requirements in road building and maintenance.

THE GALION IRON WORKS & MFG. CO.

Main Office and Works: Galion, Ohio

THERE IS A GALION DISTRIBUTOR NEAR YOU

SERVING THE CONSTRUCTION INDUSTRY SINCE 1872



You can expect—and you'll get—a full day's work, every day, from **OSGOOD** equipment, for dependable performance under any conditions is built into every **OSGOOD** machine. Since 1872, the **OSGOOD** name has been closely allied with the finest construction equipment. From this nearly three quarters of a century of manufacturing experience come the design and engineering know-how that mean more profits for you—when

you're using **OSGOOD** today!

For today, **OSGOOD** offers a complete line of shovels, cranes, draglines, backhoes, clamshells and pile drivers . . . a model and size to fit every need. Whatever your requirements, there's an **OSGOOD** machine that will do your work faster and better . . . at lower cost. Write today, outlining your particular requirements . . . complete information will be sent without obligation to you.

- POWER SHOVELS • DRAGLINES • CRANES • BACKHOES •
- CLAMSHELLS and PILE DRIVERS • 3/8 to 2 1/2 cu. yds. capacity •

THE
GENERAL
EXCAVATOR COMPANY
CRANES, DRAGLINES
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DIESEL, GAS, ELECTRIC

Associated with The General Excavator Company

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Now HAUL 20 CU. YD. LOADS ON OFF-THE-ROAD JOBS!



← 300 H.P. Walter Tractor Truck with 20 Cu. Yd. Side Dump Trailer



250 H.P. Walter Tractor Truck with 12 Cu. Yd. Back Dump Body



Walter Tractor Truck with Concrete Mixer

125 H.P. Walter Tractor Truck with Low Bed Machinery Type Trailer



WALTER Tractor Trucks haul huge yardage per truck on the tough jobs usually considered possible only for small trucks or crawlers. Walter Tractor Trucks combine payload capacity with enormous power, high speed and positive traction—yet maneuver like smaller trucks. Their non-spin, positive **FOUR** wheel traction keeps them hauling when other trucks are stopped by soft dirt, deep mud, slippery surfaces or steep grades. Specially constructed for grueling off-the-road work, they are lower in repairs, higher in availability than other trucks. Their use permits you to reduce hauling units, relieve truck congestion and speed jobs. Write for literature describing Walter Tractor Trucks in detail.

Outstanding Features of WALTER TRACTOR TRUCKS

WALTER FOUR POINT POSITIVE DRIVE prevents wheel spinning and provides more efficient conversion of engine power into tractive power.

THREE AUTOMATIC LOCKING DIFFERENTIALS proportion the power to the **FOUR** driving wheels according to the traction of each wheel at any instant.

SUSPENDED DOUBLE REDUCTION DRIVE is suspended above, not carried in axles, thus it is not subject to load strains or damage from high crowns or stumps. This construction also reduces unsprung weight and increases gear efficiency.

TRACTOR TYPE TRANSMISSION affords wide range of gear ratios.

ENGINE-AHEAD-OF-WHEELS design provides correct weight distribution and short wheelbase.

WALTER MOTOR TRUCK CO.
1001-19 Irving Ave.
Ridgewood 27
Queens, L. I., N. Y.

WALTER TRACTOR TRUCKS



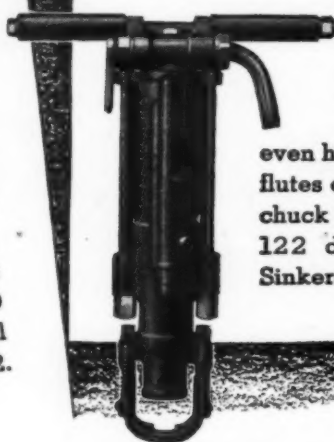
**1 for
PRIMARY
drilling...
CLEVELAND WAGON DRILLS**

CLEVELAND DR30 WAGON DRILLS are unsurpassed in maneuverability. They drill at any angle and in any direction—flat holes from 4" to 8' above ground—also straight up or down. Feed travel is over 8', permitting 6-foot steel changes, and the machine handles depths to 25' or more. The DR30 has a double screw U-bar jack, a recoil device to hold drill to its work, an improved centralizer, and a forward leg point to steady the drill. All these features make the Cleveland DR30 the most popular wagon drill ever built. Ask for Bulletin 132.



**2 for
SECONDARY
drilling...
CLEVELAND H10 SINKERS**

CLEVELAND H10 SINKERS are favorites in the 45 lb. class. Easily held, these fast cutters have strong rotation, and blow the holes with unfailing certainty. Either wet or dry construction. "T" handle illustrated is standard; open spade handle also available. All standard chuck sizes for collared drill steel, and plain or lugged shanks. Cradle mounting available for 24", 30" and 36" steel changes. The end-seating



valve improves with use—no increase in air consumption as the drill grows older. Efficient lubrication of even hard-to-reach spots like flutes of the rifle bar, forward chuck bearing, etc. Bulletin 122 describes Cleveland Sinkers in detail. Ask for it.

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The Cleveland Pneumatic Tool Company

CABLE ADDRESS: "ROCKDRILL"

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Twist & Turn

—with **FREE FLEXIBLE TRAVEL**

over **ROUGH GROUND**

WOOLDRIDGE EARTHMOVING EQUIPMENT

Includes



★ **SCRAPERS**

Tractor-drawn for handling heaping yardages from 6 to 28 cu. yards.



★ **POWER CONTROL UNITS**

Single and multiple drum with universal or roller fairleads.



★ **BULLDOZERS**

Tough and rugged design for standard makes of tractors.



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Adjustable angle-blades for standard tractor mounting



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Available in light, medium and heavy duty models with two sizes to each model.

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Hi-Speed Self-Propelled **EARTHMOVERS**

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Better Trucks ***for YOUR Business!***



TRUCK-ENGINEERED • TRUCK-BUILT • BY TRUCK MEN

“Exceptional Service from Our 70 Ford Dump Trucks ... Best in Their Field”

“We are particularly gratified with the exceptional service we have had from 70 Ford dump trucks . . . part of our fleet of 120 Ford units,” writes V. P. Loftis of V. P. Loftis Co., Engineers and Contractors of Charlotte, N. C. “These dump trucks have hauled from 3 to 5 cubic yards of earth and concrete aggregate under the most rugged conditions, and have held up better than any other truck in the same price field and of the same capacity, in our fleet. Ford Dealers have always

been most cooperative in keeping our Fords in service.”

This is typical of the performance Ford Trucks deliver where the going is tough. Fords have always been built to handle the hard jobs better. Now there are new Ford Trucks available—the best in Ford history. Examine these new Ford Trucks at your dealer's. *Get the facts about the new Ford dump truck chassis, particularly.*

FORD TRUCKS

MORE FORD TRUCKS ON THE ROAD • ON MORE JOBS • FOR MORE GOOD REASONS



ADVANCED ENGINEERING IN NEW FORD TRUCKS

*More Economy and Endurance
Easier Servicing*

A STILL GREATER 100 HP V-8 ENGINE with **NEW** Ford steel-cored Silvalay rod bearings, more enduring than ever in severe service • **NEW** aluminum alloy cam-ground 4-ring pistons for all economy • **BIGGER**, more efficient oil pump and **IMPROVED** rear bearing oil seal • **NEW** longer-lived valve springs • **NEW** improvements in cooling • **NEW** efficiency in ignition • in carburation • in lubrication • in ease and economy of servicing operations • And available in all truck chassis except C.O.E. units—the rugged, thrifty 90 HP **FORD SIX-CYLINDER ENGINE**, with many important advancements.

FORD CHASSIS ADVANTAGES: Easy accessibility for low-cost maintenance • Universal service facilities • Tough, forged front axles • Extra-sturdy rear axles with pinion straddle-mounted on 3 large roller bearings, $\frac{3}{4}$ -floating type in light duty units, full-floating in all others • 3 axle ratios available (2 in 1-ton unit) • 2-speed axle available in heavy duty units at extra cost • Powerful hydraulic brakes, large drums, cast braking surfaces • Rugged 4-speed transmission with **NEW** internal reverse lock optional at extra cost on light duty units, standard on all others.



**Again available — famous
Lincoln-ite for safer,
longer-lasting roads**

Ready to fit right into your 1946 road plans
... the pulverized petroleum asphalt that's first
choice for greater highway safety, longer road life

You've missed that famous name on road specifications.
You've missed Lincoln-ite even more on the job. Now it's
back... with all the outstanding characteristics that make it the
preferred petroleum asphalt. Of course, you remember all these
extra advantages that Lincoln-ite delivers:

- Self-renewing non-skid surface
- Greater uniformity... controlled mix
- Greater stability and durability
- Adapts itself to base movements
- Lower maintenance costs
- Can be used for lowest cost to highest type construction
- Tested and proved

Naturally, because Lincoln-ite offers so much, 1946 demand is expected to run well ahead of production. That's why it's so important to reserve your supply of Lincoln-ite *now*. And get orders in promptly for Ohio medium and rapid-curing cut-back asphalts and asphalt cements in all grades. An Ohio Oil engineer will be glad to discuss your 1946 road plans and work out a delivery schedule with you. Just write, wire or phone.

LINCOLN-ITE

THE OHIO OIL COMPANY

Producers of Petroleum since 1887

ASPHALT DEPARTMENT • Robinson, Illinois; Lovell, Wyoming



War-Proved Power for Post-War Hauling

From cable laying to road repairing, emergency duty to round-the-clock hauling, you always can depend on a GMC—the truck that's built for the job!

Its rugged, reliable valve-in-head engine is patterned after the power plant of nearly 600,000 GMC military vehicles. War-proved and improved, it has Turbo-Top pistons, full pressure lubrication, steel-backed, precision-type main bearings and many other out-

standing features that provide peak pulling power, plus exceptional economy.

And that's not all! Springs, axles, brakes, clutches, transmissions and all other parts of the GMC chassis are designed to supply super strength and stamina. The ride-ease cab increases comfort, while ball bearing steering reduces driving effort.

Remember, GMC's wide range of models . . . ½ to 20 tons . . . offers an ideal truck type for every type of public works.

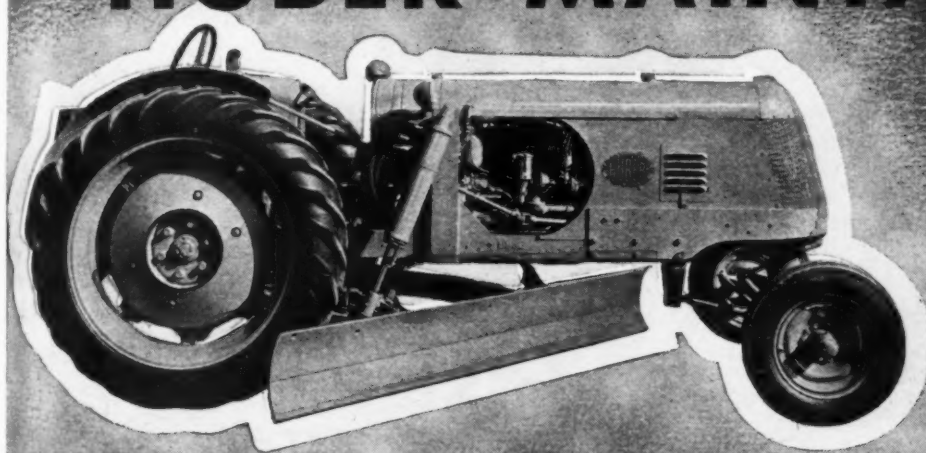
THE TRUCK OF VALUE



GASOLINE • DIESEL

GMC TRUCK & COACH DIVISION • GENERAL MOTORS CORPORATION

Versatile's THE WORD FOR THE **HUBER MAINTAINER**

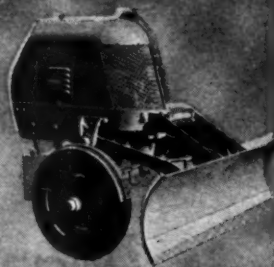


Here's an all-purpose machine which makes short work of year 'round street, highway and airport maintenance jobs . . . jobs so varied it's hard to believe a single machine could handle them successfully. Equipped with a 9' scraper blade for light sub-grading, the Huber Maintainer can be converted speedily via practical attachments into a bulldozer, snow plow, mower, sweeper, lift loader or patch roller . . . has plenty of power at the drawbar for hauling, too. To get better acquainted with this one-man "maintenance crew," write today for a Huber Maintainer specification sheet.

ONE WAY
SNOW PLOW



V TYPE
SNOW PLOW



BULLDOZER

PATCH ROLLER

LIFT LOADER

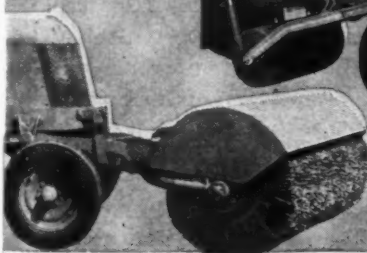


CAB

MOWER



ROTARY
BROOM



THE



MFG. COMPANY • MARION, OHIO, U. S. A.

HUBER

3 WHEEL & TANDEM ROLLERS
YEAR 'ROUND MAINTAINER

When writing advertisers please mention → ROADS AND STREETS, April, 1946



A cargo 5 million years old...

AND NEW MACK TRUCKS!



When the Pacific waters receded and the California coastline was formed, what had once been the floor of a calm bay was bared to the sun and air . . . and there lay a deposit of diatom, five miles square, 1400 feet thick—located at what is now known as Lompoc, California!

From this diatomaceous earth, now known as Celite, the Johns-Manville Company has been manufacturing everything from match heads to plastics and paints, and the entire gamut of insulation and filtration materials.

These products have added to better living. They were developed through unending research and years of hard work. So also the Macks that transported this Celite are the result of unending engineering research and an honest effort to supply a truck that will make your job easier and more profitable.

Keep pace with progress . . . make your next truck a Mack—Economical, Efficient; Harder-working with a Longer Life.

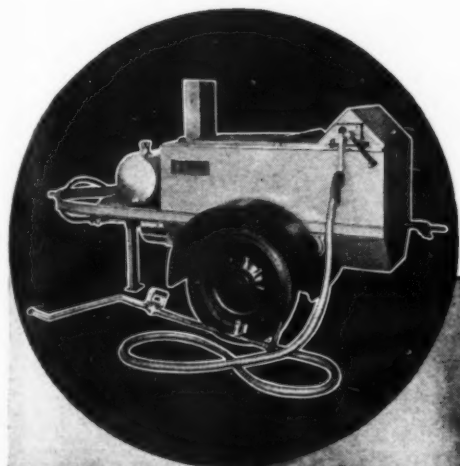
Mack TRUCKS
FOR EVERY PURPOSE



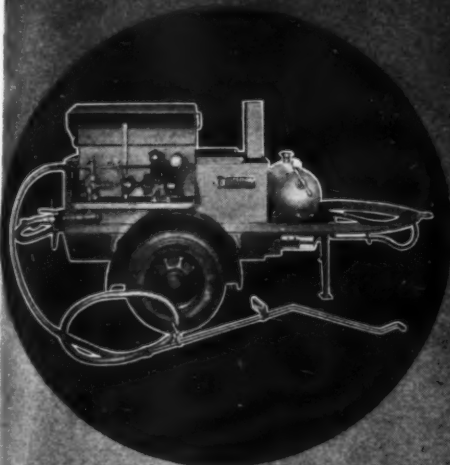
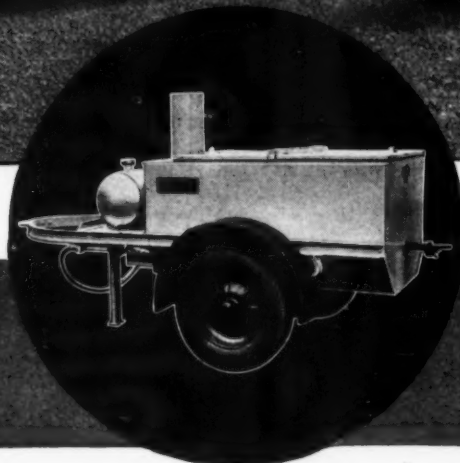
Performance
Counts

Mack Trucks, Inc., Empire State Building, New York 1, N. Y.; Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and dealers in all principal cities for service and parts.

THE 84-HD IS THE ANSWER TO PERMANENT ROAD REPAIRS



Top Circle—84-HD with Hand Spray Attachment.
Center Circle—Standard 84-HD without Spray Attachment.
Lower Circle—84-HD with Motor Spray Attachment.



When it comes to making permanent Road Repairs, the job cannot be complete without an 84-HD Kettle. This Littleford Kettle is the fastest heating Asphalt Kettle available today; in addition, it cuts the cost of operation. It has two patented features that do just that, "Double Heat Circulation" and "Screened Reservoir".

"Double Heat Circulation" system utilizes all the heat from the burner—none is wasted.

"Screened Reservoir" keeps a continuous flow of material always available—no waiting for material.

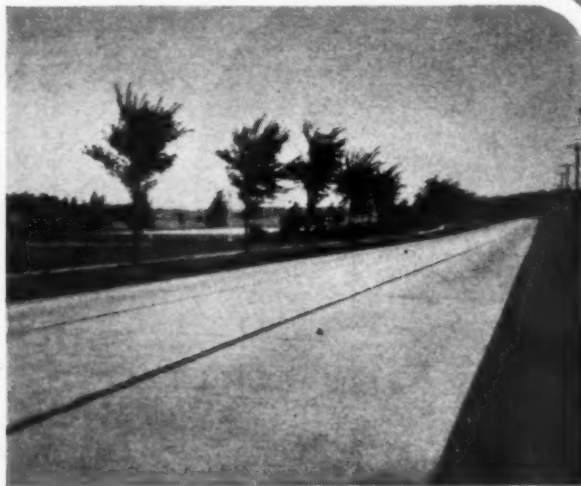
For applying Asphalt to those worn out roads or surface cuts, the 84-HD will do the job—will make the repairs permanent. For Better Roads—use the Best in Equipment—Littleford Black-Top Road Equipment.



LITTLEFORD

LITTLEFORD BROS., Inc.

454 E. PEARL ST., CINCINNATI 2, OHIO



ANY CONCRETE ROAD - ANYWHERE . . .

is better with **TRUSCON** *Welded Steel Fabric*

On every type of terrain—from mountain top to swampland—Truscon Welded Steel Fabric provides longer life and lower ultimate cost for concrete highways because it assures:

- Resistance to cracking during setting period.
- Tensile strength against subgrade friction.
- Resistance to cracking due to warping.
- Resistance to development and opening of cracks.

Resistance to slab separation.

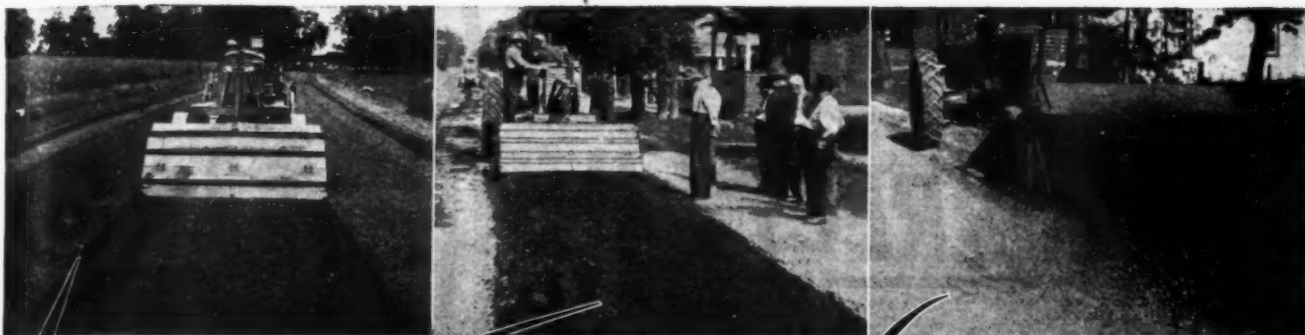
Decrease of spalling and disintegration.

Truscon Welded Steel Fabric and associated Truscon Steel roadbuilding products give adequate protection to public funds invested in highways, and will build greater prestige for you. An experienced Truscon highway engineer will help on any concrete road-building problem you may have.

TRUSCON STEEL COMPANY • YOUNGSTOWN 1, OHIO • Subsidiary of Republic Steel Corporation

TRUSCON
WELDED STEEL FABRIC





The ENGINEER MAKES A MEMO

Take out a requisition for
SEAMAN MIXER (MODEL MHD-72)
for our use in

1. Road mixing for all our soil stabilization work.
2. Road mixing in our bituminous construction.
3. Aerating to dry wet aggregates.
4. Aerating to reduce solvents to speed up set of bituminous mix.
5. Pulverizing scarified bituminous material for re-mixing.

Also requisition
SEAMAN MIXER MODEL MHD-42
(4 feet wide) for in-place
mixing on our highway
shoulder work

The famous book, "Soil Stabilization Methods", compiled by SEAMAN engineers has been completely revised and enlarged. New information developed during the war years has been added. Send for your copy today. Ask for Bulletin RS-25.

SOIL
STABILIZATION
METHODS

SEAMAN MIXER

SEAMAN MOTORS 305 No. 25th St., Milwaukee 1, Wis.

Keep 'em on the Job...

with CORRECT LUBRICATION



A VITAL factor in keeping equipment available for continuous service is correct lubrication of *every part of the vehicle*. Failure of the smallest part—due to deficient lubrication—may put the entire machine in the shop . . . and shop time is non-revenue time.

Sinclair All-Point lubrication can be your guard against equipment lay-off. Sinclair lubricants are made for *specific* service at every individual point . . . to help keep machines moving.

Try . . . OPALINE MOTOR OIL for sure, safe engine lubrication . . . non-foaming OPALINE GEAR LUBRICANT with extreme pressure properties to prevent galling and scuffing . . . OPALINE CHASSIS LUBRICANT for stay-put protection in all weather . . . SINCOLUBE for assured, enduring wheel bearing lubrication.

Let these tested lubricants help keep your equipment available . . . regularly and economically . . . always.

SINCLAIR LUBRICANTS-FUELS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.

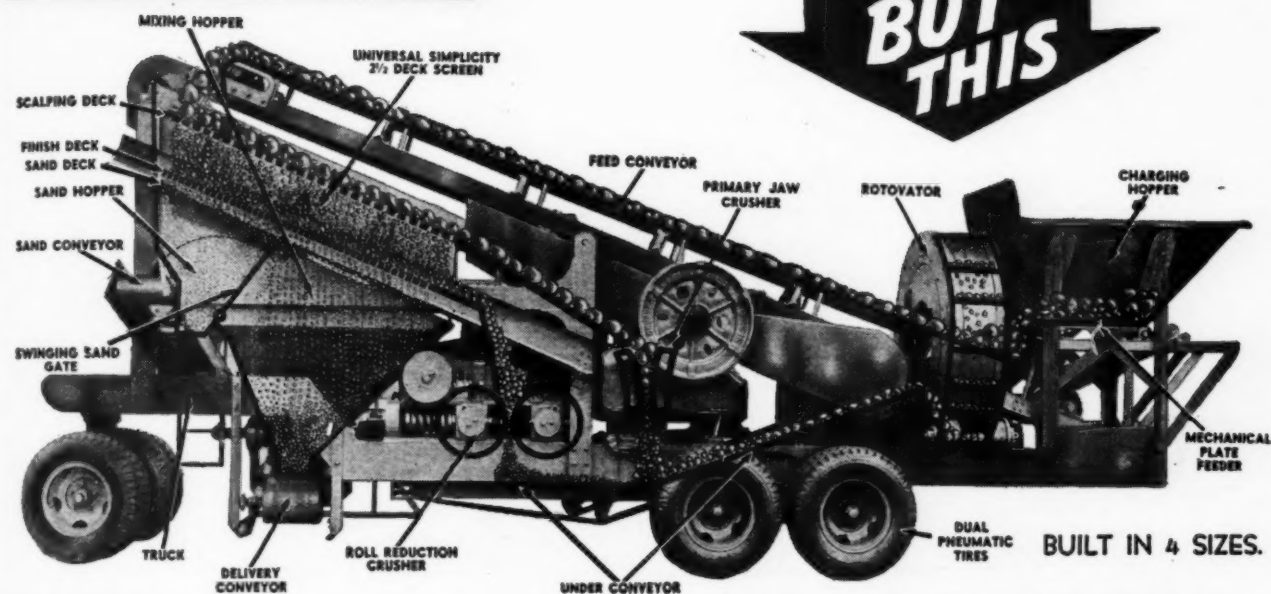
**UNIVERSAL
CRUSHING PLANTS ARE**

ENGINEERED TO THE NTH DEGREE!

Here's a Typical Example—

There are three principal methods of screening material in a gravel or rock crushing plant. Universal engineers studied them all and applied the Scalping Deck Method of screening to Universal portable and stationary plants.

**BUT
THIS**



Not This

Horizontal screening method

Material travels across screen too slowly, increasing h.p. requirements, screen wire wear and blending, lowering plant output.

Not This

Bottom deck feeding method

Pit run material all passes over finish deck, increasing wear on its small wire. All material retained by finish deck goes through jaw crusher, increasing jaw wear and decreasing output. Most of the product of the jaw crusher goes to rolls, increasing roll shell wear and h.p. requirements. Plate between decks makes screen hard to balance, increases plant vibration.

UNIVERSAL ENGINEERING CORP.

631 C Avenue West, Cedar Rapids, Iowa

Universal Scalping Deck Method

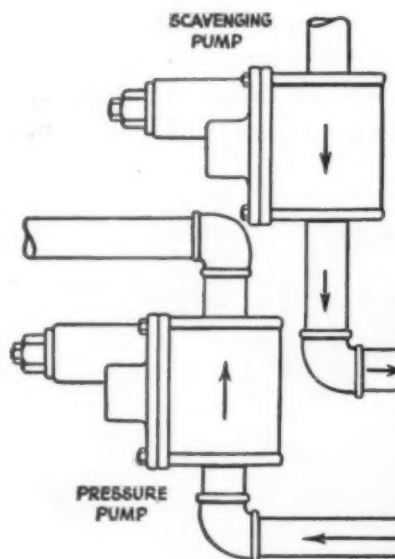
- Large oversize scalped to jaw crusher. No glutting with undersize. Result: More capacity, less jaw wear, less h.p. required.
- Rolls receive only material over finish (lower) deck—no large rocks or slabs. Result: Less roll shell wear and lower h.p. required.
- Heavy top (scalping) deck wire handles large rocks—protects finishing deck. Result: All of screening area utilized fully, longer screen wire life.
- Screen operates counterflow (uphill) against material. Result: Better gradation and higher capacity—screenable material not carried over to crushers.

The Scalping Deck Screening Method is only one of the many superior features of Universal's better engineered plants. Send for bulletins detailing other distinct features.

FOR FORTY YEARS
UNIVERSAL
ROCK AND GRAVEL CRUSHING
AND SCREENING PLANTS
ASPHALT PLANTS • SPREADER ROLLERS

Diesel Engine **DANGER** points

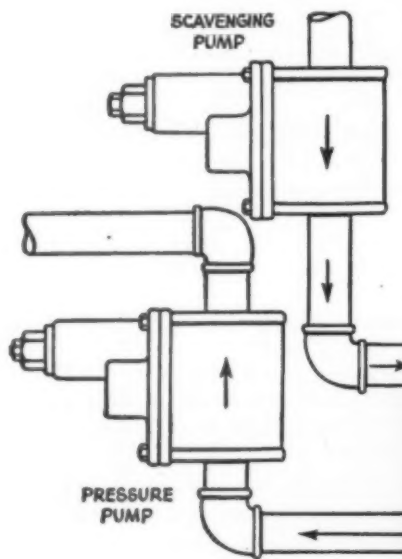
AIR BUBBLES ENDANGER OIL CIRCULATION



In Diesel engines equipped with dry-sump lubricating systems, air and oil are sucked into the scavenging pump and whipped into foam. These air bubbles may enter the pressure pump and interrupt cir-

culatation of oil, retard full flow of lubricant to bearings and other vital points. Crankcase foaming in wet-sump engines can frequently be a problem, too, and should, of course, be controlled.

RPM DELO OIL PREVENTS CRANKCASE FOAMING



To break up the formation of air bubbles and control the effect of aeration by increasing the surface tension, a "de-foamer" in RPM DELO Diesel Engine Lubricating Oil eliminates this hazard in Diesel engine operation. No matter how

much air is drawn into the oil, RPM DELO Oil is free from foam. Other compounds in RPM DELO Oil are similarly effective in preventing stuck rings and engine deposits, eliminating bearing corrosion, reducing wear.

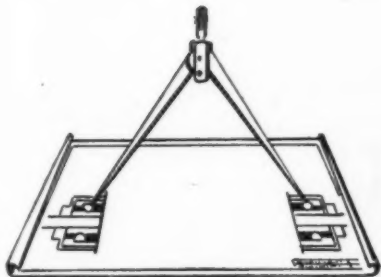
To match the fine performance of RPM DELO OIL, use these equally efficient companion products from the same famous "RPM" line—RPM HEAVY DUTY MOTOR OIL—RPM COMPOUNDED MOTOR OIL—RPM GEAR OILS AND LUBRICANTS—RPM GREASES. For additional information or name of your distributor, write any of the companies below:

STANDARD OF CALIFORNIA • 225 Bush St., San Francisco 20, California
THE CALIFORNIA COMPANY • 17th and Stout Streets, Denver 1, Colorado
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • 30 Rockefeller Plaza, New York 20



GOOD MAGNETOS

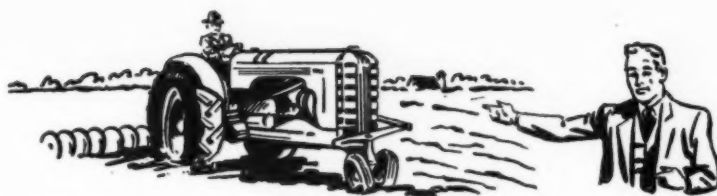
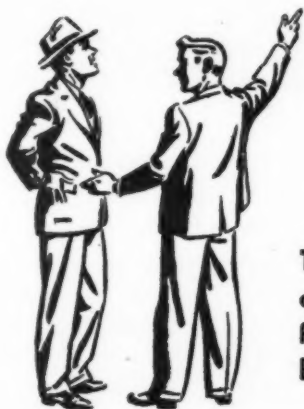
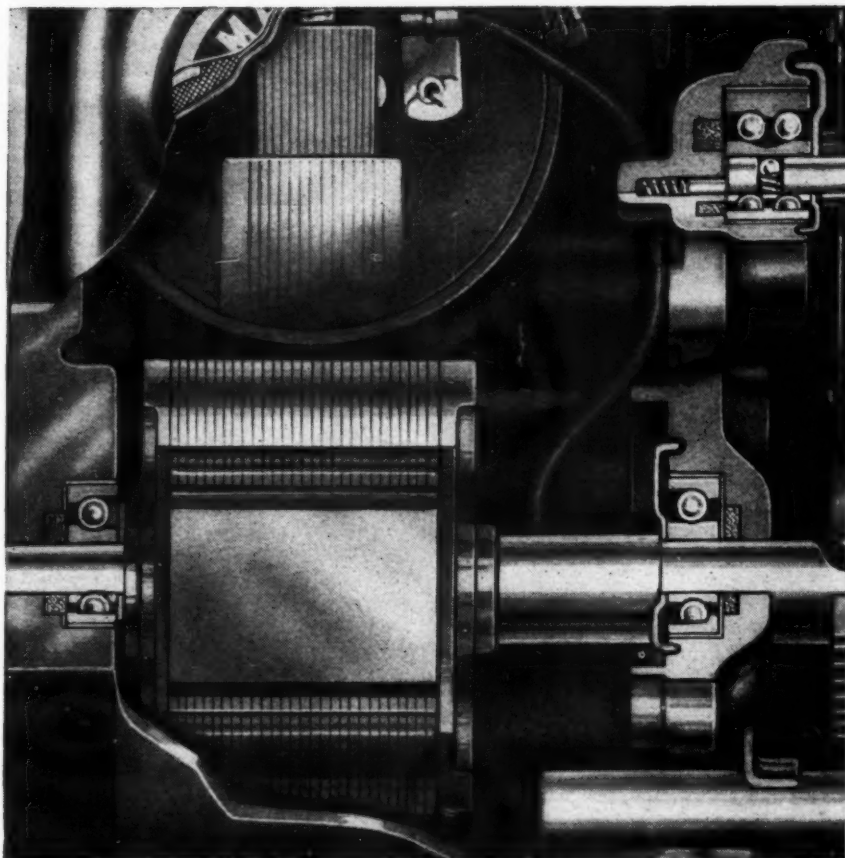
have Correctly-spaced Bearings



CORRECT SPACING IS VITAL. It is vital that spacing between rotor and rotor tunnel be maintained to hair-line accuracy. This can be done only by correctly-spaced bearings, maintaining proper alignment of the rotor under all operating conditions.

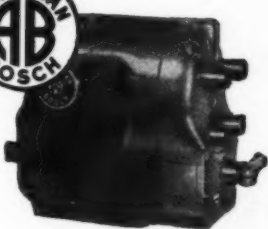


AMERICAN BOSCH MAGNETOS have correctly-spaced bearings for longer life and smoother, more-dependable performance.



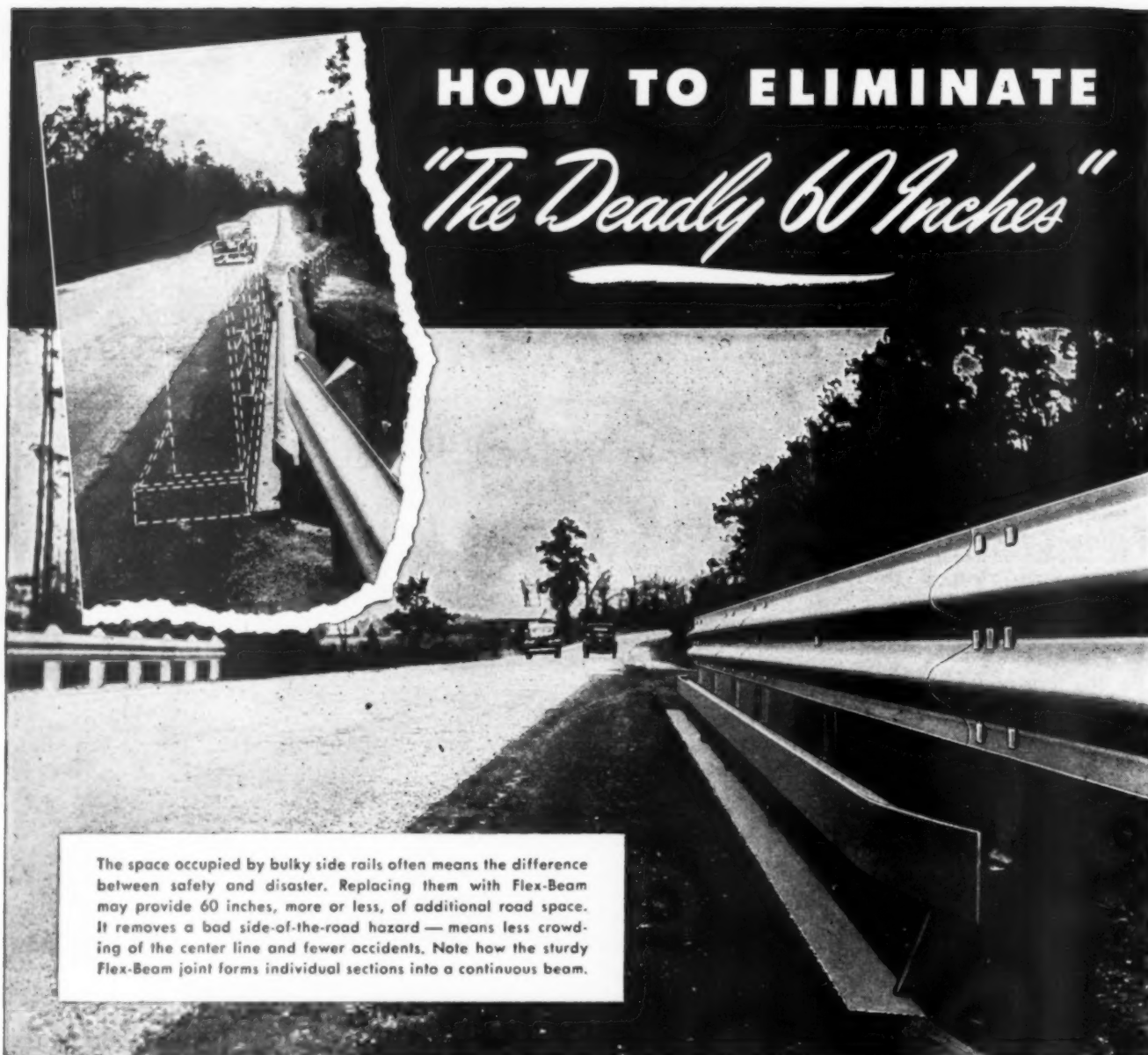
THEY CAN TAKE IT. They stand up under the most gruelling conditions because they are balanced for smooth, vibration-free performance. You'll find many such hidden values behind the American Bosch trademark on all types of automotive electrical equipment.

AMERICAN BOSCH CORPORATION, SPRINGFIELD 7, MASS.



AMERICAN BOSCH

Super-Powered Magnetos



HOW TO ELIMINATE *"The Deadly 60 Inches"*

The space occupied by bulky side rails often means the difference between safety and disaster. Replacing them with Flex-Beam may provide 60 inches, more or less, of additional road space. It removes a bad side-of-the-road hazard — means less crowding of the center line and fewer accidents. Note how the sturdy Flex-Beam joint forms individual sections into a continuous beam.

When narrow bridges squeeze traffic you can "let out the seams" by replacing bulky railings with Flex-Beam Guard-rail. It is equally practicable for new construction. And by making the rail continuous through the bridge and beyond the ends you have an efficient, economical safety approach.

Providing a wider roadway is only one of Flex-Beam's many advantages. It is easy to install and can readily be adapted to any type of bridge construction. Unskilled labor does the work quickly with simple tools. Any type of posts may be used and "deadmen" or other outside supports are not required.

Although light in weight Flex-Beam has designed strength that means uniform resistance to impact at every point. It looks sturdy and *is* sturdy. This plus high visibility—day or night—promotes driver confidence and added safety. The elimination of heavy railings often permits the bridge to carry greater live loads. Painting is easy and little or no other maintenance is needed.

You'll also find Flex-Beam an ideal guard rail for curves, high fills or wherever else it is needed to protect motorists. Write for complete information. Armco Drainage & Metal Products, Inc., and Associated Companies, 1755 Curtis St., Middletown, Ohio. Sheffield Steel Corp., Kansas City, Mo.



Flex-Beam **GUARDRAIL**

FROM START . . .



TO FINISH !

Includes a lot of territory, to be sure, especially when you're talking about the design and construction of a huge unit such as this Hanson Model 41 Excavator.

The Hanson Company's insistence on high quality starts with drawing board design. It carries right on through the purchase and specifications of materials and parts. During the machining and assembly of parts the employees at Hanson have caught the spirit of "It's got to be right"!

Little wonder that Hanson owners and operators have only praise for this equipment. They enjoy the ultimate benefits of the "Start to Finish" quality which really adds up in on-the-job performance. The Excavator comes in two sizes: $\frac{3}{8}$ yd. and $\frac{1}{2}$ yd. A more intimate picture of Hanson Excavator features and construction is yours for the asking.

Write for the latest catalog RS-46.

These are some of the features that play a part in the "Start to Finish" Hanson design:

Air Controlled Steering . . . All welded steel construction . . . Timken Roller Bearings at all vital points . . . Chain crowd . . . Full revolving . . . Low center of gravity . . . Special Hanson clutches, easily adjusted and relined without dismantling shafts . . . Extra long crawlers . . . Heavy duty industrial type gasoline or diesel motors. Quickly convertible to Crane, Dragline, Clamshell or Trench-hoe.

Other Hanson products which have this characteristic "Start to Finish" quality are: Yard & Dock Cranes, Truck Shovels, Heavy Duty Machinery Trailers. Write for more information on any of these, indicating the equipment in which you are interested.

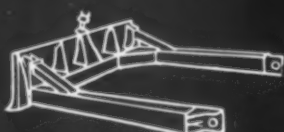
HANSON

CLUTCH AND MACHINERY
COMPANY - TIFFIN, OHIO

Details That Mean DEPENDABILITY!

Operators aren't afraid to put their Buckeye Dozers and Trailbuilders to any test, because they know they'll take the toughest jobs in stride. This dependability adds up to more profit per contract through faster, smoother operation, lower maintenance costs, and more productive time on the job through less time out for adjustment and repair.

THESE DETAILS ASSURE DEPENDABILITY:



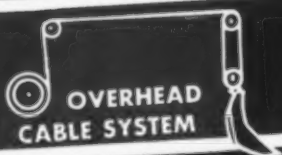
MOLDBOARD DESIGN

MOLDBOARD DESIGN—Rugged Buckeye Moldboard is structurally braced vertically and horizontally for extra strength with minimum weight. It will take all the stress a tractor can impose, either straight or at an angle.



BALANCED

BALANCED—Buckeye's balanced weight distribution keeps full length of crawlers on ground while working—assures maximum traction—minimizes slipping.



OVERHEAD
CABLE SYSTEM

OVERHEAD CABLE SYSTEM—Buckeye's overhead cable system provides fast, smooth operation. Large sheaves, minimum cable turns assure long cable life, negligible power loss.



POWER CONTROL UNIT

POWER CONTROL UNIT—Brakes and clutches are so built that they must take hold of the load smoothly, without jerking, eliminating impact strains, and permitting the economy of smaller cable with efficiency and long life. Efficient application of power is assured.

BUCKEYE TRACTION DITCHER COMPANY
FINDLAY, OHIO

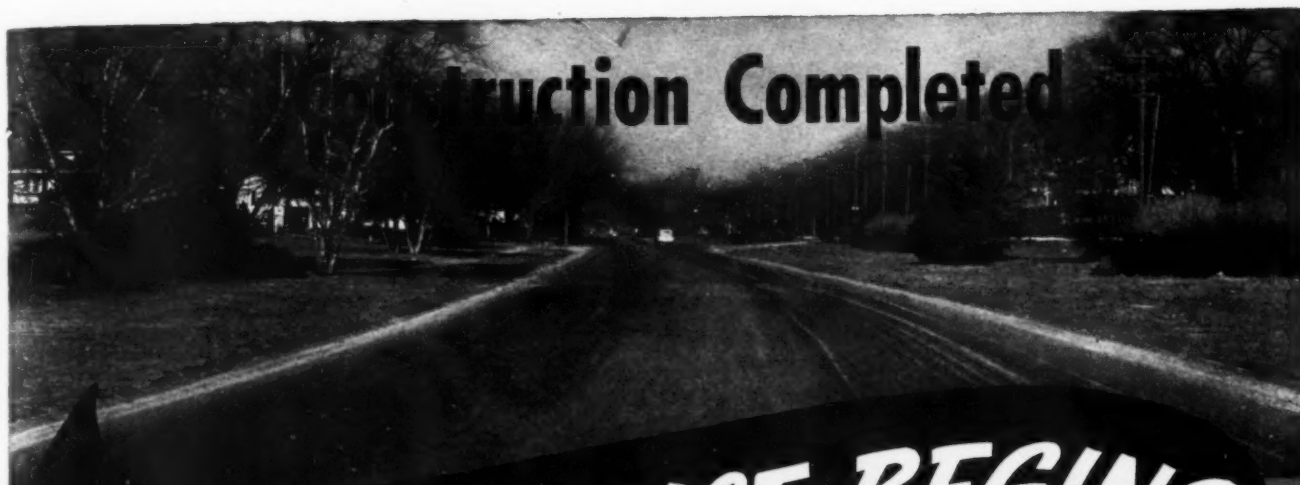
Another cost-cutting Buckeye! The 1/2 and 3/4 yard Buckeye Clipper Convertible Power Shovels. Send for your copy of "Age of the Clippers" today.



Built by

Buckeye

CONVERTIBLE SHOVELS—BULLDOZERS—ROAD WIDENERS
TRENCHERS—MATERIAL SPREADERS—R-B FINEGRADERS



Construction Completed MAINTENANCE BEGINS



PRESSURE DISTRIBUTORS

Used in construction and maintenance of highways, streets and airports. Spraybars up to 24 feet in length.

MAINTENANCE DISTRIBUTOR

Drives material through Spray Bar or through Hand Spray. For maintenance and patch work or new construction.



TAR KETTLE

Can be equipped with either Hand Operated or Gas Engine powered Pump for use with Hand Spray.



OTHER PRODUCTS

Emulsion Spray Units • Kerosene and Distillate Burners • Supply Tanks • Tool Heaters • Asphalt Tools • Street Flushers

Proper and effective maintenance of pavements, is fully as important as proper design and construction procedure. As is true with all other types of construction, maintenance must begin the day after construction is completed, and must be continuous throughout the year.

The primary objects of maintenance are: (1) keep a smooth surface, assuring quick and effective runoff; (2) keep the underlying base or subgrade dry; and (3) maintain contact between pavements and underlying courses. This requires effective slopes leading to drainage outlets, one hundred percent waterproof surface, and continual correction for consolidation or movement in supporting courses below. There is no substitute for preventive maintenance and constant patrolling is essential in order to detect and correct today those conditions which would progress into failures next year.



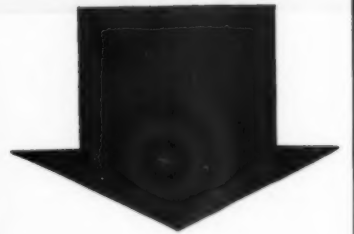
SALES OFFICES IN PRINCIPAL CITIES

Standard Steel Works

NORTH KANSAS CITY, MO., U. S. A.



132,737
... and



7 MILES in 26,571 HOURS d they're still young!

Red Lake County, Minnesota, has 500 miles of road—about 85% of which is gravel. The “Caterpillar” Diesel Motor Graders shown here handle practically all of the maintenance and improvement work —at a constant saving in taxpayers' money.

For example: The fuel savings alone amounted to more than \$4500 in 26,571 hours of operation, as compared to former equipment using a different type of power. These machines also did up to 45% more work for every hour consumed in covering 132,737 miles.

In rain or sunshine—in temperatures ranging from 110° above zero to 40° below—these tough, powerful, long-lived “Caterpillar” Diesels keep going—on blading, reshaping, stabilizing, scarifying, back-sloping, black-topping, ditching, culvert work and snow plowing.

“No work or weather condition is beyond the ability of this splendid Motor Grader,” is the way Highway Engineer Bert J. Pinsonneault (opposite page) puts it. And that's a nutshell description of the ruggedness and dependability of everything “Caterpillar” builds.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT



The discharged veteran wears this emblem. Remember his service and honor him.



Using sheep's foot roller to compact Soil-Cement mixture during construction on Route 32 near Bonner Springs, Kansas in 1940.

Photograph shows excellent condition of Soil-Cement paving on Route 32 west of Bonner Springs, Kansas after five years of service. Built by Kansas State Highway Commission.



SOIL-CEMENT

your logical buy for light traffic paving

Engineers have established the practical value of Soil-Cement paving for light traffic roads, streets and airports by building more than 39 million square yards of such paving in the United States. This paving provides continuous, all-weather service.

The low cost of Soil-Cement is ideally suited to light traffic paving programs. Since about 90 per cent of the required Soil-Cement material is usually on existing roadways or streets, construction costs naturally are low.

With Soil-Cement you can transform old high-maintenance gravel and stone roads into strong, long-lasting pavements.

Compare the cost and service of other types of paving intended for the same purpose, with Soil-Cement, and you'll see why it is the logical choice for your light traffic roads, streets and airports.

Send for "Specifications for Soil-Cement Road and Street Construction," to help you complete your secondary paving program. Free in United States and Canada.

PORTLAND CEMENT ASSOCIATION

Dept. 4-28, 33 W. Grand Ave., Chicago 10, Ill.

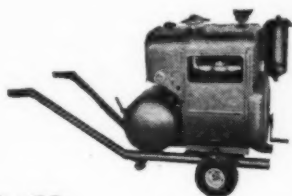
A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

Run your eye over this wide
range of

SCHRAMM

AIR COMPRESSORS

SIZES FROM 20 TO 420 CU. FT. ACTUAL AIR



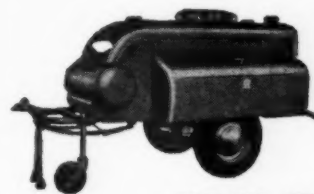
**No. 20
ON SHOP TRUCK**

The No. 20 compressor is a complete self-contained unit available in various types of mountings and with an actual air delivery of 20 cu. ft. per minute.



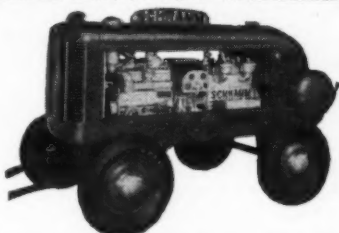
**60 CU. FT.
DE LUXE WITH TOOL BOXES**

The two wheel trailer type mounting is designed for rapid and inexpensive transportation behind truck or car.



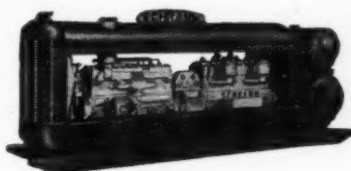
**105 CU. FT.
WITH SWIVEL TYPE WHEEL**

This trailer type mounting is provided with a universal coupling or towing ring for connection to car or truck for hauling at maximum towing speed.



**105 CU. FT. WITH STREAMLINE
FUEL TANK**

A pneumatic tired mounting used generally for rapid transit over town and country highways. Lighter weight and better balance provide easier handling.



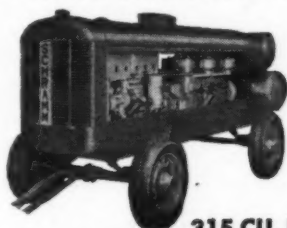
**210 CU. FT.
STANDARD SKID MOUNTED**

This unit is easily loaded on to a motor truck body for temporary use or for transportation, and can also be used for temporary or permanent stationary installation without addition of foundation.



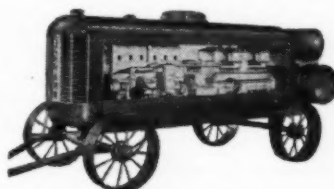
**210 CU. FT.
MOTOR TRUCK MOUNTING**

Any of the Standard self-aligned Schramm compressor units complete with streamline tool box and built-in fenders are available for mounting on truck chassis.



**315 CU. FT.
ON SPRING TRAILER**

The Spring Trailer, with pneumatic tires and semi-elliptical springs front and rear, is equipped with an automotive type steering assembly to provide perfect balance on any and all turns.



STEEL WHEEL MOUNTING

All size Schramm compressors are available in this type mounting with heavy, wide steel rims for easy portability in tough terrain.



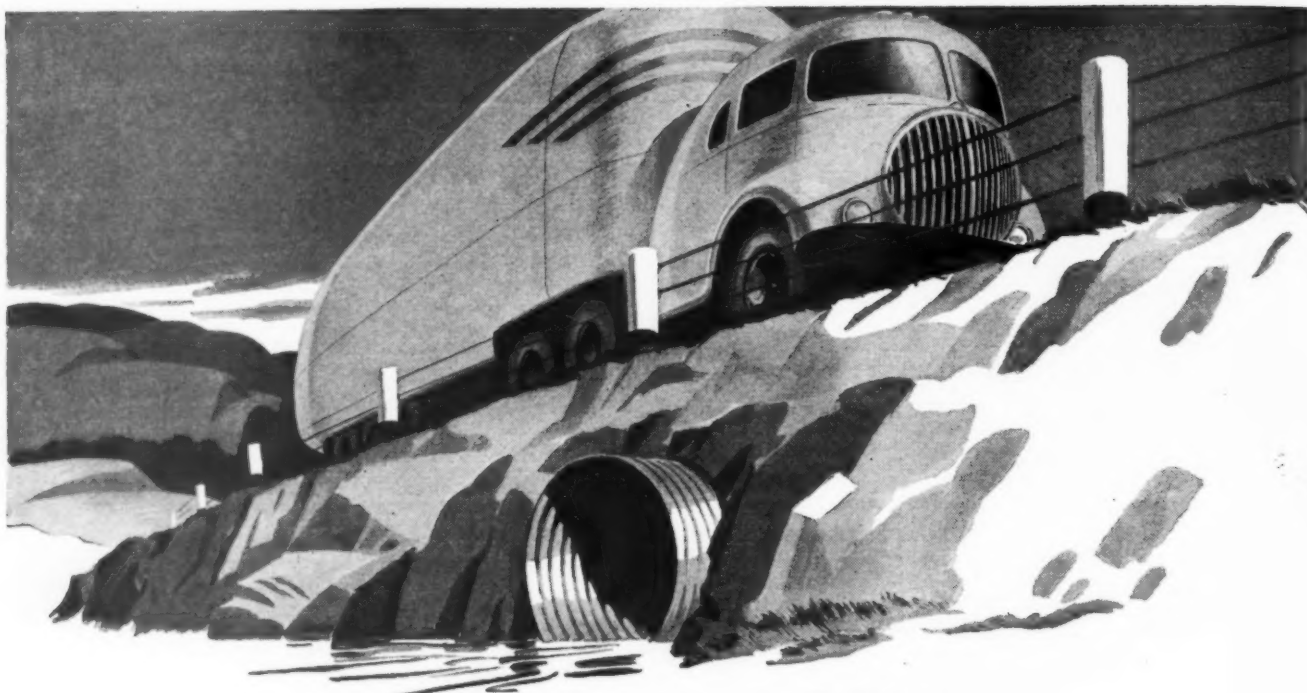
420 CU. FT.

DIESEL ENGINE DRIVEN

Schramm Diesel Engine Driven units are available in sizes ranging from 105 to 420 cu. ft. of free air.

SCHRAMM INC.

COMPRESSOR SPECIALISTS
WEST CHESTER
PENNSYLVANIA



Toncan Corrugated Pipe

IS STRONG AS SAMSON AND LASTS A LIFETIME

HERE IS A COMPLETE LIST OF TONCAN IRON DRAINAGE PRODUCTS

CORRUGATED METAL PIPE

6" to 84" diameters: any length in multiples of 2 ft. Gages No. 16 to No. 8 Galvanized with or without biminous coating. Complete line of standard or special fittings.

PERFORATED METAL PIPE

For subdrainage. 6" to 30" diameters: lengths in 2 ft. multiples. No. 16 or 14 gage. Complete line of standard or special fittings.

CORWEL PIPE

6" diameter. No. 18 or 16 gage. Perforated or non-perforated. Lengths to 24 ft. Helical corrugations. Galvanized after fabrication.

SECTIONAL PLATE PIPE

Field-erected using individual plates and special bolts. 5 to 15 ft. diameters. No. 7 to No. 1 gage. Corrugations designed for maximum strength.

SECTIONAL PLATE ARCHES

Wide range of spans and rises. Same type plate construction as above. Base and headwall materials determined by local conditions.

FLOOD GATES

Automatically control water flow in only one direction. 8" to 36" diameter designed for attaching directly to corrugated metal pipe.

It takes strong culverts to stand up under the heavy loads carried by modern highway giants. That's why drainage structures should be built with Toncan Iron Corrugated Pipe. It's strong, flexible, able to stand tremendous loads without cracking or crumbling. And Toncan Iron Corrugated Pipe is not affected by vibration, severe weather changes, settling, etc.

Toncan Iron Corrugated Pipe is made from an alloy of highly refined open-hearth iron, twice as much copper as found in copper-bearing steel, and molybdenum, which resists rust and corrosion caused by water, soil and sewage. Thus, drainage structures made from this durable material often last longer than the utility for which they are installed.

These facts, plus the advantages of 100% salvage value and light, unbreakable sections which reduce shipping, hauling, handling, laying and installation costs, make Toncan Iron Corrugated Pipe the most economical drainage structure on the market.

The long experience of Toncan Engineers is at your disposal to help solve your drainage problems. Write and tell us when you want one of these specialists to call. Toncan Culvert Manufacturers Association, 1112 Standard Bank Building, Cleveland 13, Ohio.



CALL ONE OF THESE TONCAN FABRICATORS FOR FAST SERVICE

ALLMETAL HIGHWAY PRODUCTS, INC.
Ligonier, Indiana

BEALL PIPE & TANK CORPORATION
1945 N. Columbia Blvd.
Portland 3, Ore.

BERGER METAL CULVERT CO. OF N. E.
420 Somerville Avenue
Somerville 43, Mass.

THE BOARDMAN COMPANY
1401 S. W. 11th Street
Oklahoma City 1, Okla.

CENTRAL CULVERT COMPANY
409 Guaranty Bank Bldg.
Alexandria, La.

CHOCTAW, INC.
Second at Butler St.
Memphis, Tenn.

DOMINION METAL & CULVERT CORP.
Roanoke, Virginia

EATON METAL PRODUCTS CORP.
13th and Willis Ave.
Omaha, Nebraska

EATON METAL PROD. CO. OF MONTANA
18th and 5th Avenue, N.
Billings, Mont.

EATON METAL PRODUCTS CORP.
KANSAS DIVISION
Hutchinson, Kansas

EMPIRE STATE CULVERT CORP.
Gorton, New York

ILLINOIS CORRUGATED CULVERT CORP.
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Peoria, Ill.

JENSEN BRIDGE & SUPPLY COMPANY
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REPUBLIC STEEL CORPORATION
CULVERT DIVISION
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Canton, Ohio

16th & Washington Ave.
Philadelphia 46, Pa.

THOMPSON PIPE & STEEL COMPANY
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Denver 1, Col.

TRI-STATE CULVERT & MACHINERY CO.
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Atlanta 1, Ga.

WESTERN PIPE & STEEL COMPANY
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WISCONSIN CULVERT COMPANY
201 So. Ingersoll St.
Madison, Wis.

WYATT METAL & BOILER WORKS
Dallas 2, Texas



Heil Fleet Helped Speed Grand Coulee Project

A fleet of 12 trucks, equipped with Heil Rock Bodies, moved 480,000 tons of rock and other excavated material over 372,000 miles of difficult terrain in less than six months.

This feat is one more proof that Heil Rock Bodies and Hoists have the ability to perform dependably under the toughest operating conditions.

Heil Rock Bodies stand up and take the pounding—day after day

... because they're correctly reinforced
for long wear



Heil body with single-cylinder hoist.

Heil heavy-duty body
with twin-cylinder hoist.



Specialized engineers designed this husky model to take the terrific day-in, day-out punishment of handling rock and ore. Sturdy channels, closely spaced, give this unit a ruggedness that assures dependable, profitable operation with minimum "down-time" for costly repairs and maintenance.

You can save time and money and increase your hauling profits by using the famous Heil heavy-duty rock body. Write for complete details. Ask for bulletin.

BH-120

THE HEIL CO.

GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

Use **KOTAL** Master Mixes for Bituminous Surfaces All Year 'Round



It's easy

It's easy to keep bituminous surfaces in condition all the year 'round with KOTAL Mixes. These cold mixes, tested and proven in more than six years of hard use, produce tough, durable surfaces and solid repairs that resist stripping and stand up indefinitely. Prepared by advanced scientific methods, using high-grade cutback asphalts or road tars, KOTAL Mixes have these unique features:

EIGHT WORKING FEATURES OF KOTAL MASTER MIXES

EASY TO USE. Quickly mixed, ready to lay. No preheating or drying.
STABILITY. Cure quickly and permanently. Do not shift, ravel or pick up. Open sooner to traffic.

WORKABILITY. Do not adhere to equipment. Work easily.
LONG-TERM STOCK PILES. Can be stock-piled for many months without losing workability.

SAVE TIME. Quickly made stock piles ready for immediate use without frequent fresh mixes.
SAVE LABOR. Actual road records prove fewer labor hours required.

SAVE MONEY. Savings in time and labor mean economies in road costs.
EXTEND PAVING SEASON. All-weather workability permits more months of operation.

IT'S THE KOTAL PROCESS THAT MAKES THE DIFFERENCE

Write for your copy of booklet which tells the story of KOTAL MIXES.

We will also send you the name of your nearest supplier.



KOTAL COMPANY ★ 52 Vanderbilt Ave. ★ New York 17

KOTAL Master Mixes

The Advanced All-Weather Aid in Building Better Roads

UNIT'S "Big 3"

Designed for FASTER and EASIER OPERATION . . . where the Going is TOUGH!

UNIT 1020

¾-Yard Shovel



Here are three time-tested UNIT machines that continue to "make the headlines" because of their unusual speed, efficiency and all-around dependability. Check the following exclusive UNIT features: Compact, streamlined design . . . Straight line engine mounting . . . Drop forged alloy steel gears . . . Automatic traction brakes . . . Interchangeable disc type clutches . . . One-piece cast gear case . . . and above all, UNIT's safety-promoting FULL VISION CAB. No other excavator on the market has all these features.

**CONTACT FACTORY DIRECT
for Price and Delivery**

UNIT CRANE & SHOVEL CORP.

UNIT 514

½-Yard Dragline



**ALL Unit Models
are Convertible to
ALL Attachments**

UNIT 357

5-Ton Mobile Crane with
Magnet Attachment.



**MILWAUKEE 14,
WISCONSIN, U.S.A.**

Anthony HAS IT...

**CONSTRUCTION
EQUIPMENT
THAT KEEPS TRUCKS ON
THE MOVE**

- ANTHONY "SUPER" HYDRAULIC HOISTS AND BODIES, up to 30 ton capacity — with "power speed lift" and "rubber restraining blocks," two of many features that explain the evident preference for Anthony equipment on the job.
- ANTHONY HYDRAULIC LIFT GATE... one of the remarkable new war-developed pieces of equipment for loading and unloading. Raises and lowers loads from ground to truck level.
- ANTHONY MATERIAL SPREADER... rugged, all steel; for road building, maintenance and ice control.
- ANTHONY HYDRAULIC PLATFORM "BOOSTER" HOISTS, especially designed to make dump bodies out of flat bed trucks. Write for complete details on any Anthony product. Available through all truck dealers and Anthony distributors.



Manufactured by **ANTHONY CO.** Streator, Ill.



**FOR
LONGER ROPE LIFE—
WICKWIRE SPENCER
WIRE ROPE
—IN ALL SIZES AND
CONSTRUCTIONS
—FOR EVERY NEED.**

Constant, careful control through every step of manufacture assures dependable performance, safety and long life in Wickwire Spencer Wire Rope.

**HOW TO PROLONG ROPE LIFE
AND LESSEN ROPE COSTS . . .**

Thousands of wire rope users—old hands and new—have found "Know Your Ropes" of inestimable value in lengthening life of wire rope. Contains 78 "right and wrong" illustrations, 41 wire rope life savers, 20 diagrams, tables, graphs and charts.

SEND FOR YOUR FREE COPY



Send your wire rope questions to

**WICKWIRE SPENCER
STEEL**



A DIVISION OF THE
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EXECUTIVE OFFICES—500 FIFTH AVENUE, NEW YORK 18, N. Y.

Abilene (Tex.) • Boston • Buffalo • Chattanooga • Chicago • Denver • Detroit
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CECO EXPANDS ITS MANUFACTURING PLANT TO BETTER SERVE YOU



In 1946 plant enlargement exceeding 50% starts a development program encompassing 14 plants and 23 sales offices coast to coast.

Now CECO ENGINEERING Means More Than Ever in the Highway Construction field

Work is already far along on expansion of Ceco's great Chicago plant. The new facilities should be available for use by summer. Further expansion of plants, warehouses and offices from coast to coast will follow as rapidly as conditions permit. This expansion means greater

availability of Ceco precision-engineered highway products—even fuller technical engineering service. Ceco's aim is to supply you always with fine products and perfect service—where you want them—when you want them.

CECO STEEL PRODUCTS CORPORATION

MANUFACTURING DIVISION, 5659 WEST 26TH STREET, CHICAGO 50, ILLINOIS

Concrete Engineering Division, Merchant Trade Division, Highway Products Division
Offices, Warehouses and Fabricating Plants in Principal Cities

In construction products CECO ENGINEERING makes the big difference

Typical Ceco Highway Products

Welded Wire Fabric
Reinforcing Steel
Metal Center Strip
Transload Devices
Stake Pins
Dowel Supports and Sockets
Expansion Joints
Cecore Curing Compound and
Applicators
Joint Sealing Compound
Sub-grade Paper

**Mail This Handy Coupon
For Free CECO Catalogs**

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Please send me free descriptive
literature on Ceco Highway Products.

Name

Address

City State

FLINK SPREADER DOES MORE

...Ideal for all types of Highway Spreading

- Enables you to spread more volume per day
- Speed to spreading area, start spreading without stopping truck
- Finish spreading—speed to next spot without stopping truck
- Operated entirely by driver with cab clutch
- Spreads all granular materials up to 1" width of street
- Spreads forward or backward—full or half width of street
- Does not limit use of truck—won't interfere with dumping
- Attaches to truck as tailgate-off in 5 min.
- Self-feeding—no helper required. Safer!

SELF-FEEDING
FLINK



Illustration above shows new safety housing now used on Flink WD31 and HD4. Model WD31 is chain driven from rear wheel. Model HD4 has a hydraulic drive. Both controlled from cab. Illustration right: safety cover removed.



FLINK COMPANY, DEPT. 8, STREATOR, ILL.

"La Crosse" HIGH SPEED CARGO TRAILER

Order Now for June Delivery

22'
to
30'
Lengths



- * 18,000 LB. TUBULAR AXLE
- * 16½ x 7 AIR BRAKES
- * 12 TON CAPACITY

- * STAKE BODY
 - * TIRE CARRIER
- Optional Equipment

LA CROSSE TRAILER & EQUIPMENT CO.

418 Gould Street - Phone 4220 - La Crosse, Wisconsin

NEW IMPROVED SUPER-LUBRICANT

FOR TOUGHEST LUBRICATION JOBS
IN CARS, TRUCKS, TRACTORS AND STATIONARY ENGINES



- Resists Formation of Sludge, Lacquer, Carbon
- Removes Hard Carbon
- Stronger Protective Film
- Non-Corrosive—Safe
- Keeps Piston Rings Free
- Adds Power, Saves Fuel, Saves Wear and Shut-down Time

Accepted by Leading Engine Manufacturers as a Superior Lubricant.

LION *Naturalube*
D.H.D. OIL

Naturalube D.H.D. is made from a rare and basically different crude oil which imparts to the finished product a stronger protective film . . . greater adhesiveness and penetrativeness . . . and ability to remove hard carbon deposits. By special processing, Naturalube D.H.D. is reinforced against the deteriorating effects of extreme heat and oxidation. Because of D.H.D.'s resistance to formation of deposits of sludge and lacquer, engines are clean-

er; rings and valves operate freely for longer periods; filters, screens and oil lines function normally. There is no hard-carbon scuffing; general engine performance is greatly improved; operating and maintenance costs are lower; shut-down time is minimized. D.H.D. is non-corrosive—safe. It saves wear, adds power and saves fuel. Try D.H.D. —Your money back if you don't believe it to be the best oil you have ever used.

**For normal service where D.H.D. is not required, use Naturalube Motor Oil (not so heavily reinforced.)*

POSITIVE MONEY-BACK GUARANTEE

For further information about Naturalube Oils, see the local Naturalube Distributor or write direct to Lion Oil Company, El Dorado, Arkansas.



LION OIL COMPANY

EL DORADO, ARKANSAS

**NO WAITING!
NO DELAY!**

**BARNES NOW MAKING STOCK SHIPMENT
On 2-in. (7M) Pumps**



THE STREAK (7M)

For quick handling to and from and on the job, the Barnes Streak (7M) is your answer. Automatic-prime, base-mounted, or equipped with wheels, and powered by the dependable Wisconsin AB engine. Ball-type handle makes moving easy. **REMEMBER—IT'S SHIPPED FROM STOCK—IMMEDIATE DELIVERY—NO WAITING.**

Get going on your job immediately. No Waiting—no delays in getting a pump from Barnes. You can have 1 or 100 of the Barnes 2-inch (7M) Automatic Centrifugal Pumps shipped to you from stock immediately upon the receipt of your order.

Barnes' ability to produce these finer and better 7M Pumps in volume will extend to other sizes in the complete line (3,000 to 90,000 G. P. H.) of Barnes Automatic, as the days pass. And remember, no finer, no better pumps can be had—for Barnes Automatics are the pumps that deliver "MORE GALLONS OF WATER FOR YOUR PUMPING DOLLAR."

ATTENTION DISTRIBUTORS! A number of choice territories are still open. Write, phone, or wire.



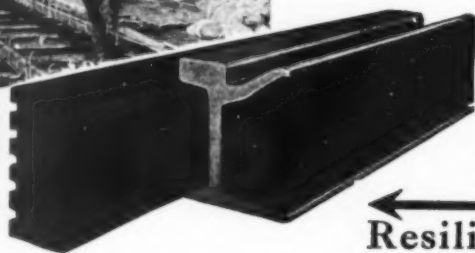
BARNES MANUFACTURING CO.

Quality Pump Manufacturers for 50 Years

MANFIELD, OHIO



CITY STREETS REQUIRE PAVEMENTS TO BE IN SOLID CONTACT WITH RAILS.



Servicised

**PREMOLDED
RAIL FILLER
FOR TRACK
INSULATION**

**MUFFLES NOISE BY
DIMINISHING VIBRATIONS!**

← **Holds Rails Solid, But in
Resilient Contact With Pavement.**

Servicised—Bituminous Resilient Rail Filler Cuts Down Maintenance Costs for Both City and Railway Company by Eliminating Expansion & Contraction Damages.

NATURE OF OUR RAIL FILLER

Through many long years of successful service our resilient Rail Filler has more than proved its inherent value to both city and Ry. company. Waterproofing spaces between rails and pavement have prevented infiltration, freezing, cracking and costly deterioration; also eliminating problems of vibration, noise, contraction, expansion and costly re-alignments. Street Railway Systems are possibly the largest users of Servicised Rail Filler, but it is also frequently used where interstate or interurban railroads run in contact with city pavements for distances of a few blocks to several miles.



SERVICISED PRODUCTS CORP.

6051 WEST 65TH STREET

CHICAGO 38, ILL.

- **Gross Weight**
- **Dipper Capacity**

BY ANY YARDSTICK

- **First Cost**
- **Operating Cost**



... the $\frac{3}{4}$ Swing Badger, with its low center of gravity (for digging power), and lighter swinging weight (for more swings per minute), moves *more material, faster and cheaper.*

AUSTIN-WESTERN COMPANY
AURORA, ILLINOIS, U. S. A.



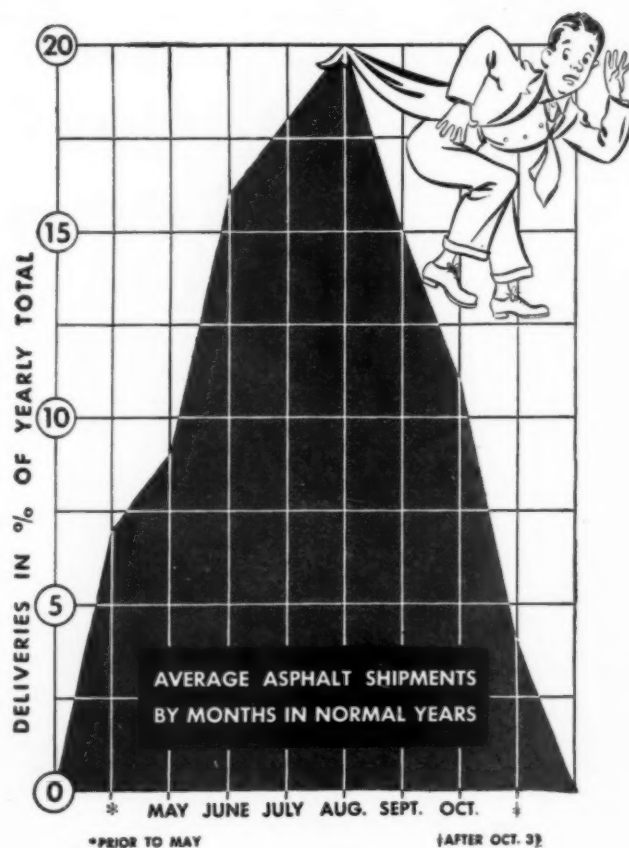
NO TAIL SWING permits work
in close quarters

BUILDERS OF ROAD MACHINERY
Austin A Western
SINCE 1859

Don't get hung up at the peak of the season

THAT MOUNTAIN in the chart at right represents average monthly asphalt deliveries. It is also an indication of when road building is heaviest in normal times. Road building for 1946 promises to be two or three times greater than in normal years. Think what this will mean if normal schedules are followed. Quarries and gravel pits will be swamped with orders. Equipment will be overtaxed to maintain schedules. Refineries are preparing for a plentiful supply of asphalt, but if orders are concentrated in two or three summer months, delays may occur. Someone is certain to get caught short.

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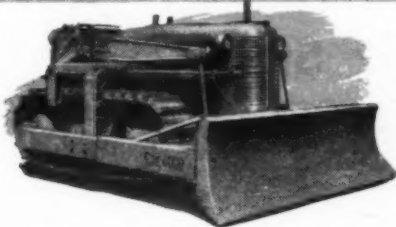
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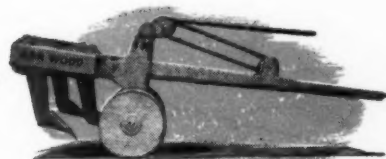


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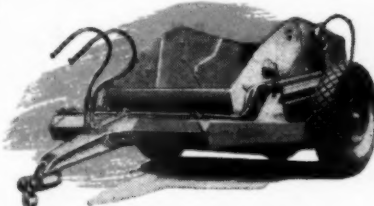
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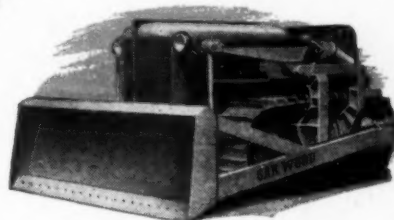
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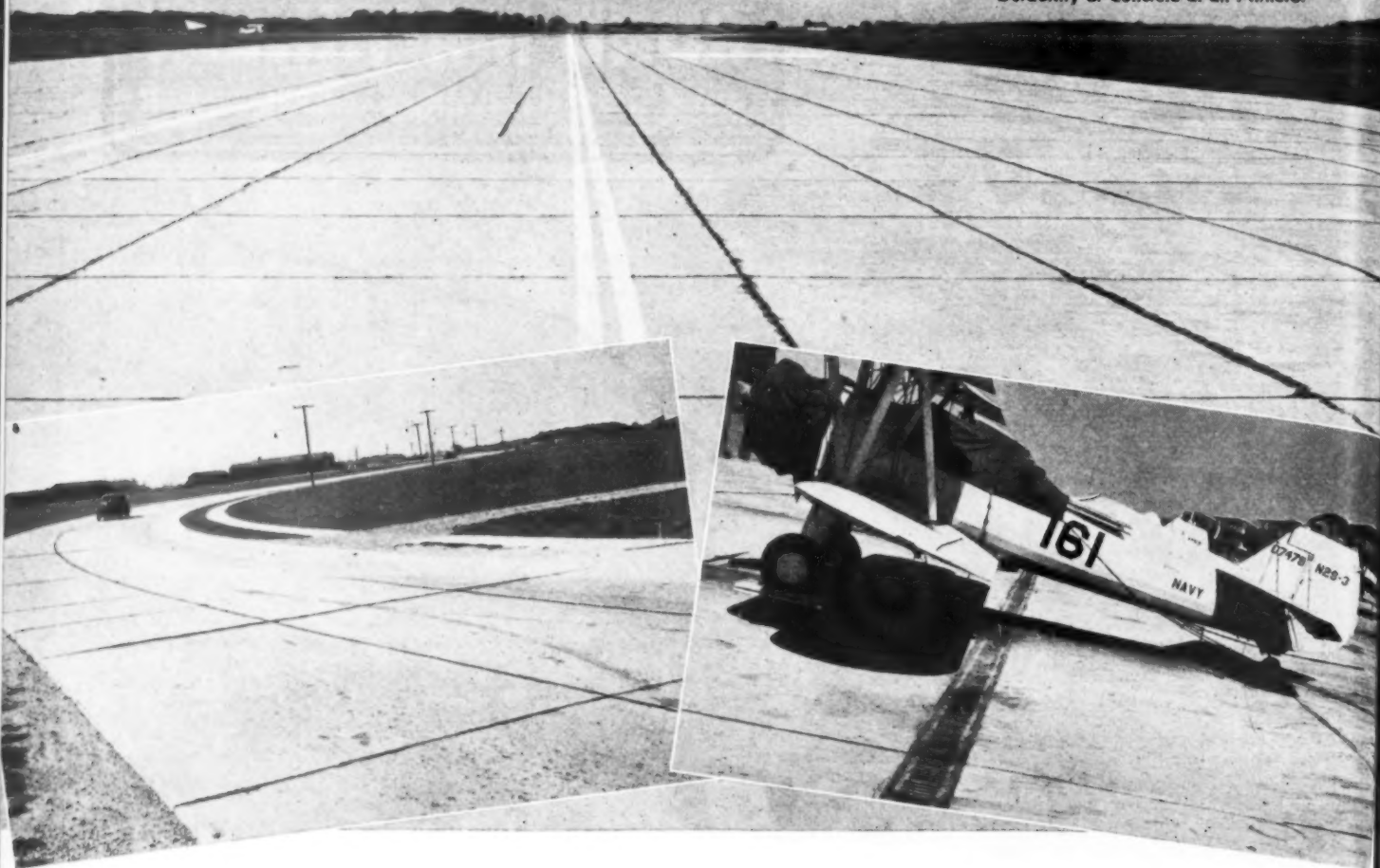
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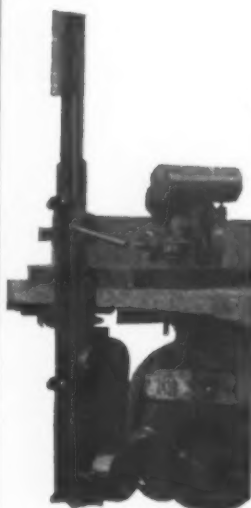


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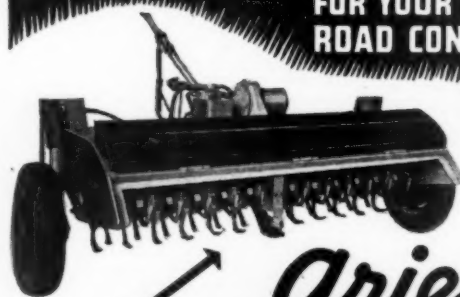
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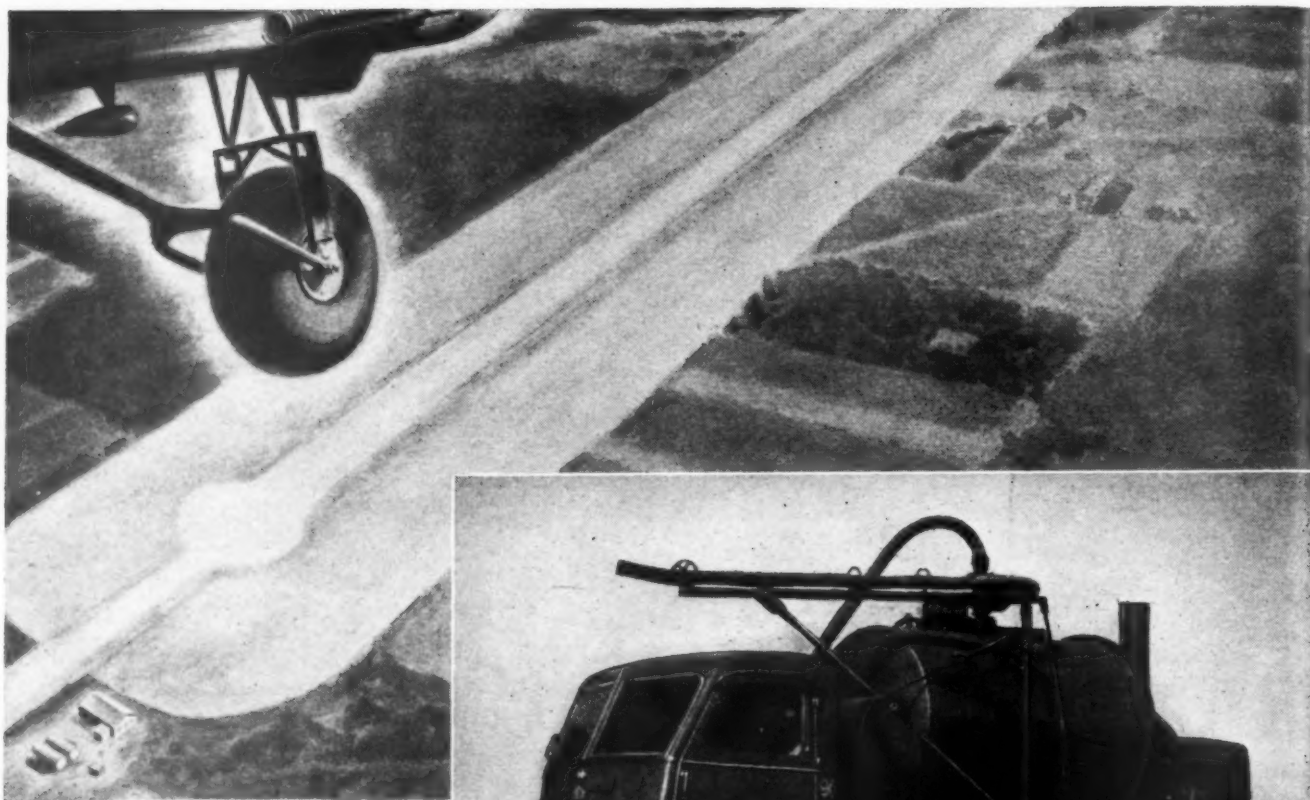
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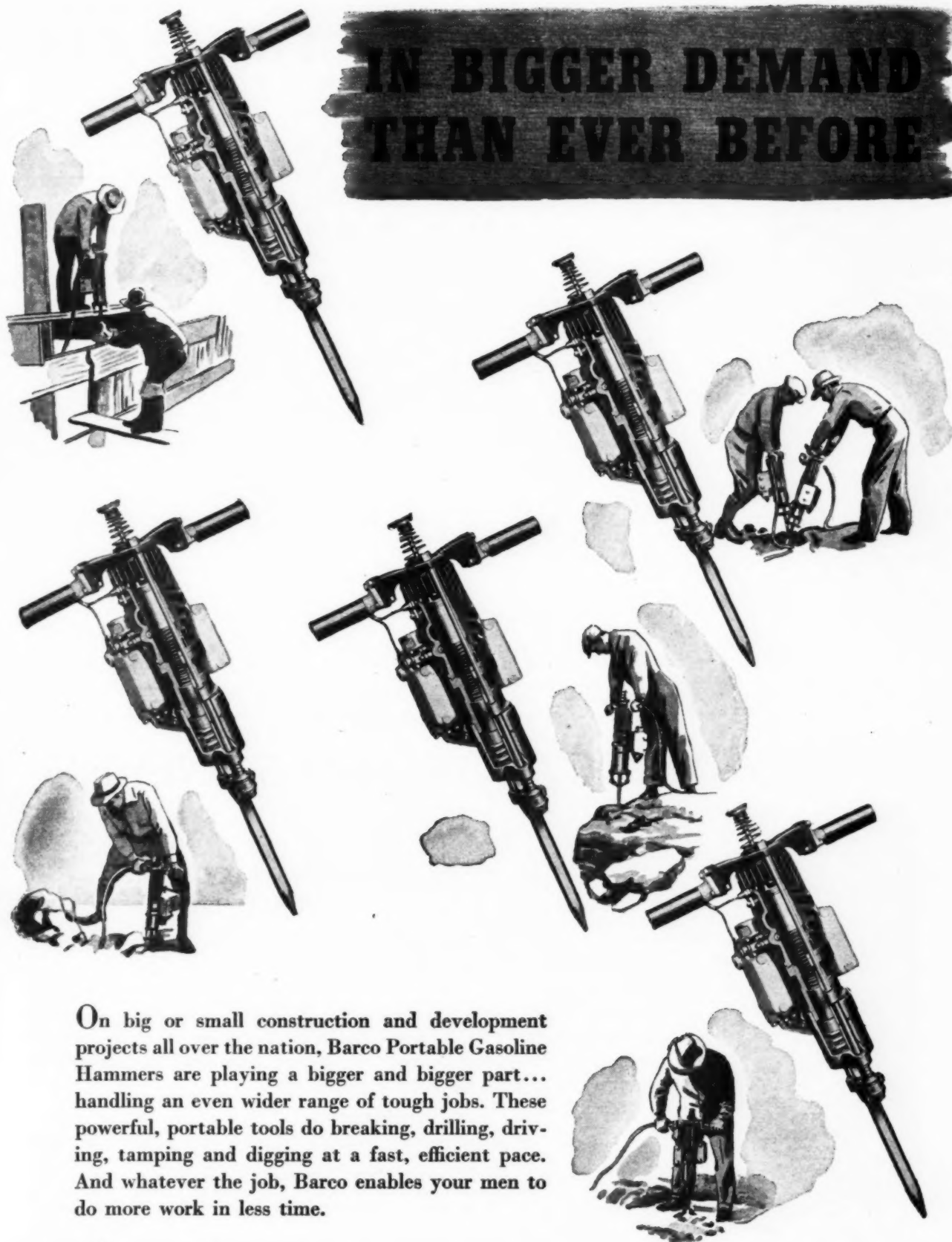


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By H. K. Glidden

Eastern Editor, ROADS AND STREETS

NEW York City's new municipal airport at Idlewild, on the south shore of Long Island, has presented problems, the like of which were never heard of before, by those who have had anything much to do with the project. The city fathers haven't even been able to settle on a name for the place yet. Engineers, contractors, airlines, labor unions, as well as city and government officials, found themselves in the same boat; there just weren't enough precedents to go around when they tackled the design,

construction and operation problems involved in putting together the first super-colossal global air terminal.

Downer, Green and Carrillo of New York City, consulting engineers for this mammoth project, have naturally come in for the lion's share of the headaches. Not the least of the headaches was occasioned by water, something which, when the airport goes into operation, will be most conspicuous by its absence. Pilots, from all over the world, will not have to give so much as a single thought to water and its weakening effect on the pavement waiting to receive their high-speed airplanes, weighing a hundred

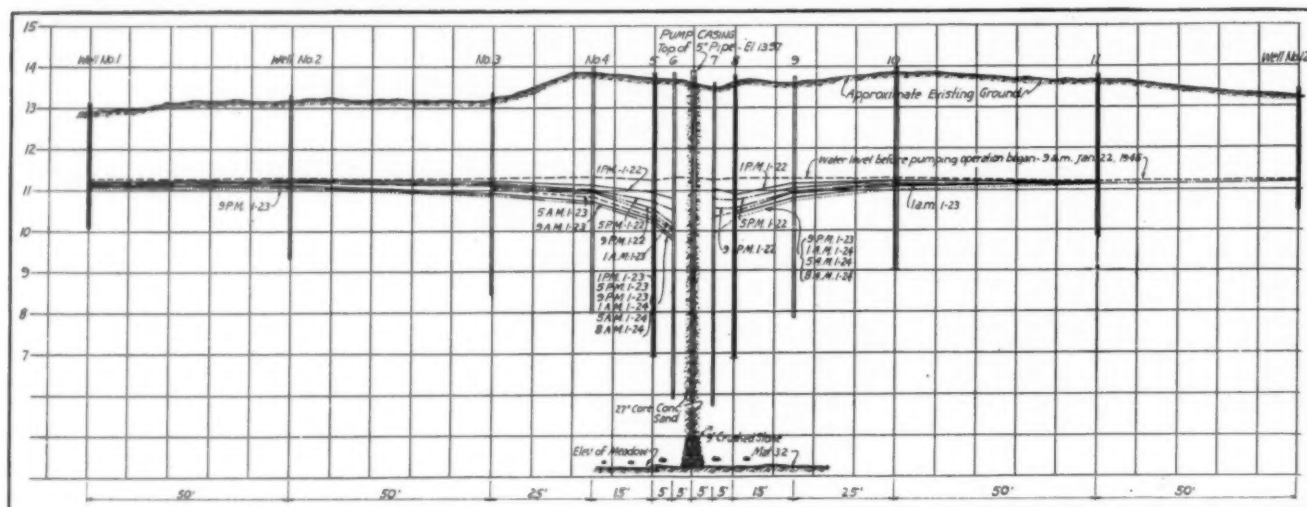
tons or more. The engineers did this thinking and it took a lot of it.

Continued Complications

Idlewild now contains about 4,800 acres. The central terminal area alone will involve 512 acres, a large share of which is 14-in. concrete pavement. The first three runways completed total 480,000 sq. yd. of pavement. Disposing of the water from such an area, in a manner that will not interrupt airplane operations day or night, year in and year out, was difficult enough to plan for. To complicate matters, the size of the airport was increased at least four times. Original



★ At Idlewild Airport—completed 72-in. line junction chamber in foreground. Note well point system and pumps at right



★ Fig. 1. Cross-section horner test well

plans in 1941 called for only 1,198 acres. Add to this the fact that speed was of the essence. This airport had to be placed in operation before January 1, 1946, the date Fiorello LaGuardia turned the city over to his successor, Mayor William O'Dwyer. The reason the deadline was not met is another story, but it doesn't involve the engineers—they were ready. Downer, Green and Carrillo expect to do rush jobs, in fact they say they like them, but it got in their hair somewhat when the city, C.A.A. and the airlines could not agree on the final runway layout until April, 1945.

All of the sewage and storm water from a large section of Long Island had previously crossed the Idlewild area. Re-routing these sewers would have been routine, except that someone, years ago, used up all the fall in getting to the near edge of the airport. Securing final approval of the

plans for this portion of the work involved a number of agencies. Since all of them were not completely sold on the overwhelming importance of Idlewild, this was no easy hurdle.

Dense Graded Sand Holds High Water Table

Prior to starting the airport, the elevation of the tide-flat area was at plus 5 above mean low tide, or at about mean high water, and was covered with a typical meadow mat. Some 53,000,000 cu. yd. of sand, pumped in from Jamaica Bay, brought the site up to an average elevation of about 13 ft. Under this loading, the meadow mat was compressed on an average to about one-half its original thickness. When it was later examined in the bottom of a caisson, the inspectors characterized it as a firm, hard clay with some vegetable matter. Special tests which were carried out later

proved that this mat was practically impervious to downward percolation.

Consolidation of the fill and compression of the mat caused no trouble. Check levels started in 1941 revealed that the greater part of the subsidence occurred in the first six weeks, and that it became immaterial at the end of a year.

On the recommendation of Horner & Shifrin, a large number of observation wells were installed in the sand fill, and records were taken of the water table elevation before and after each rain. These permitted preparation of a contour map of the water table and a determination of hydraulic gradients of ground water.

The hydraulic fill did, however, trap water in pockets. Heavy equipment such as scrapers or batching trucks would cause miniature geysers to spout every time they ran over such an area until all the trapped water was forced out. Marsh gas entered the picture, bringing up highly technical discussions of the effect gas might have in holding ground water at a high elevation in the fill.

While not a design problem, low visibility due to a fog or blowing sand was no help to progress. Survey parties, running topography or setting grade stakes, experienced considerable difficulty in finding their way on numerous occasions after having become completely lost.

The temperature in this area falls to zero and below often enough, and for sufficiently long periods of time, to make frost a factor that had to be dealt with.

Downer, Green and Carrillo called in Horner and Shifrin, St. Louis, for

★ Pipe was backfilled with clam buckets. One-third of an essential 200,000 lin. ft. of pipe, ranging from 8 to 72 in. will be needed at Idlewild Airport

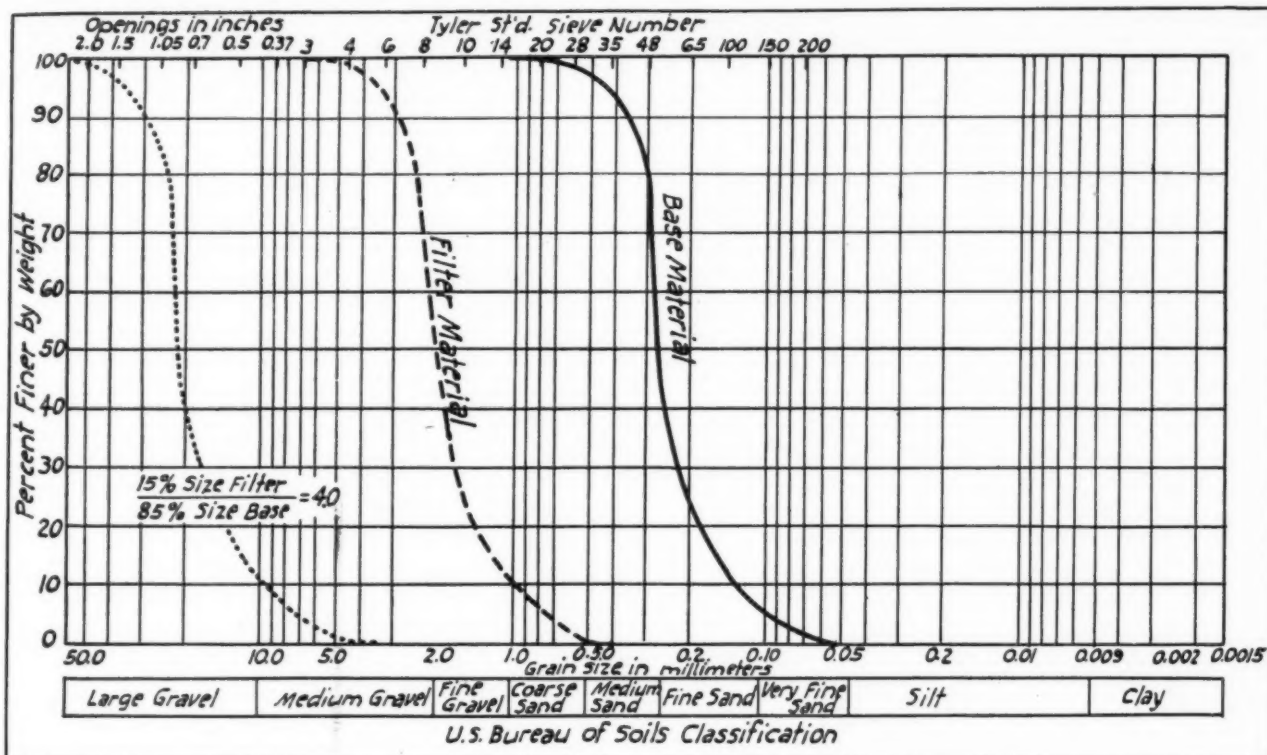


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★ Fig. 2. Filter material gradation curves

technical assistance. They also organized a drainage committee for consultation and study. While the members of the committee were chosen for their technical knowledge, familiarity with drainage conditions along the south shore of Long Island was their prime qualification. I. V. A. Huie, Commissioner of Public Works, John Riedel, Chief Engineer of the Board of Estimate and Sidney Shapiro, Assistant Chief Engineer of the Long Island State Park Commission, made up the committee. These three men gave freely of their time and advice. They looked over and analyzed all research data and findings. Dr. Wheeler, geologist for New York City's Department of Public Works,

made available his experience with Long Island sand and marshes to help make the solution simpler.

Design Based on Tests

Realizing that their problem was unique in many respects, the engineers did not rely on hand-book data. Test projects were set up on the job to secure answers to basic questions.

The first step was a careful mechanical analysis to determine the grain sizes of the pumped-in material. Fortunately, the sand proved to be quite uniform over the entire area.

Ground water level was carefully checked by readings taken from the various test wells. It was found that 1 in. of rainfall raised the ground

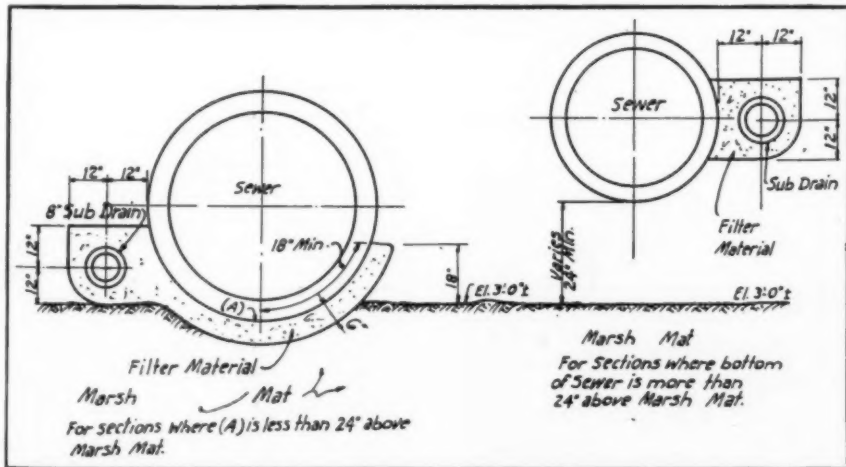
about 1 ft., and that the normal ground water level remained consistently 12 to 18 in. below the ground surface regardless of surface elevation.

The "K" value of the hydraulic fill sand was determined by laboratory tests on both re-compacted and undisturbed samples, and a considerable variation was indicated. This condition indicated the propriety of further studies and a re-computation of this value by test pumping as described in the following paragraph.

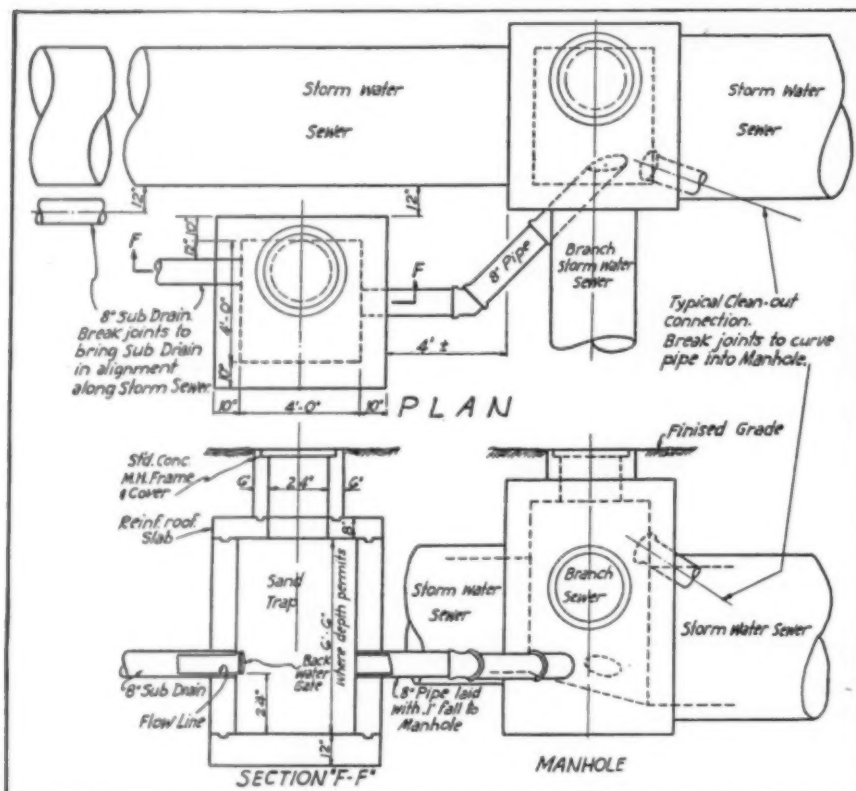
Horner Test Wells

The rate at which water would travel laterally through the pumped-in sand and the form of the de-watering curve were considered to be information essential to designing sub-surface drainage. To secure these data, W. W. Horner designed test wells to allow a record to be made of actual results. Fig. 1 is a cross section of the Horner test well system.

A 2-in. self-priming centrifugal pump was used to keep all water removed from the control well for a period of 40 to 48 hours. The amount of water removed was measured in drums and then dumped far enough away as to not affect the test. Readings of the water level in the recording wells were taken every hour. The results of two such tests were plotted and showed very similar de-watering curves even though one well averaged 542 gal. per hr., while the other averaged only 170 gal. per hr. The curves showed little lowering of ground



★ Fig. 3. Typical section—storm sewer and sub-drains



★ Fig. 4. Typical sand trap and connection to storm sewer system

water level further than 50 ft. from the control well, and that ground water returned quite slowly after pumping operations ceased.

As the result of all the studies, the drainage engineers determined that only 10% of the annual rainfall was being disposed by movement laterally through the sand to the Bay, and only a small additional amount was percolating downward through spots where the underlying brown sands outcropped through the marsh mat. It developed actually that the

bulk of the rainfall was being disposed of by evaporation from the wet sand surface when the water table was within 2 ft. of that surface. When heavy rains occurred, water flushed to the surface and ran out over the sand to the Bay. This information gave the necessary background to determine proper drainage policy.

Design Standards

Upon completion of preliminary conferences and investigations of site conditions, the design standards were

agreed upon and adopted. An outline of these standards follows:

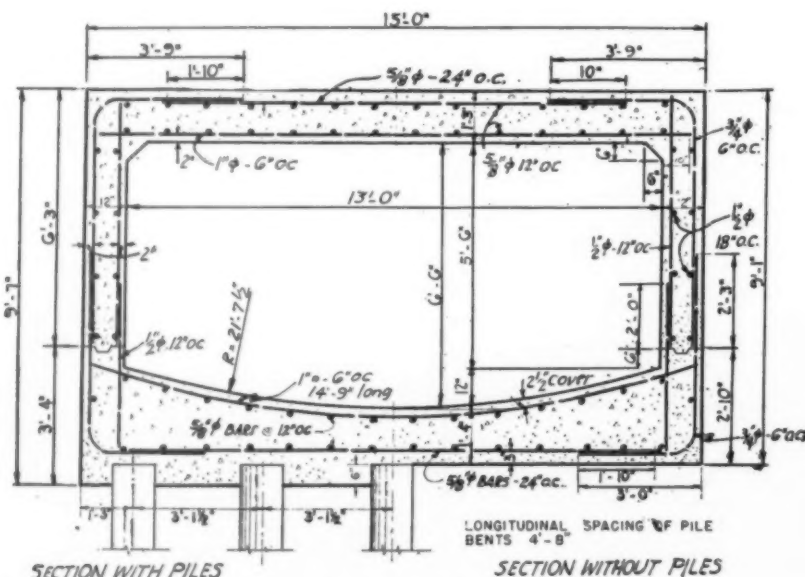
1. Design for 300,000-lb. wheel loading; or 75,000 lb. per wheel on dual wheels 5 ft. apart with allowance of 25% for vibratory effect where planes warm up or taxi to any appreciable extent.
2. All drainage structures to possess best possible hydraulic factors.
3. Immediate run-off from runway pavements.
4. Ponding of gutter overflow to be allowable in sod areas adjacent to aprons.
5. Ground water level under pavement to be kept below frost line.
6. Strength of all storm drain pipe at least equal to A.S.T.M. C76-41, Table 2.
7. Joint sealer to be plastic material.
8. Compaction of trench backfill required.
9. Gutter type pavement section for runways.
10. Install drainage along taxiways similar to that for runways.
11. Off-pavement area water to be removed by ponding and vertical infiltration.

Because of the very flat grades at which the storm sewers had to be laid, pipe of large sizes was required. This in turn indicated that a considerable amount of the run-off would be taken up in filling the conduits. A method of design was therefore developed by Horner & Shifrin which involved the routing and combining the hydrographs of inflow from the various inlets along the line. This exact method, while providing the required accuracy, resulted in an enormous amount of work because of the frequent layout changes occasioned by changing runway locations. Taking the guesswork out of pipe sizes, however, undoubtedly resulted in the most economically-safe design.

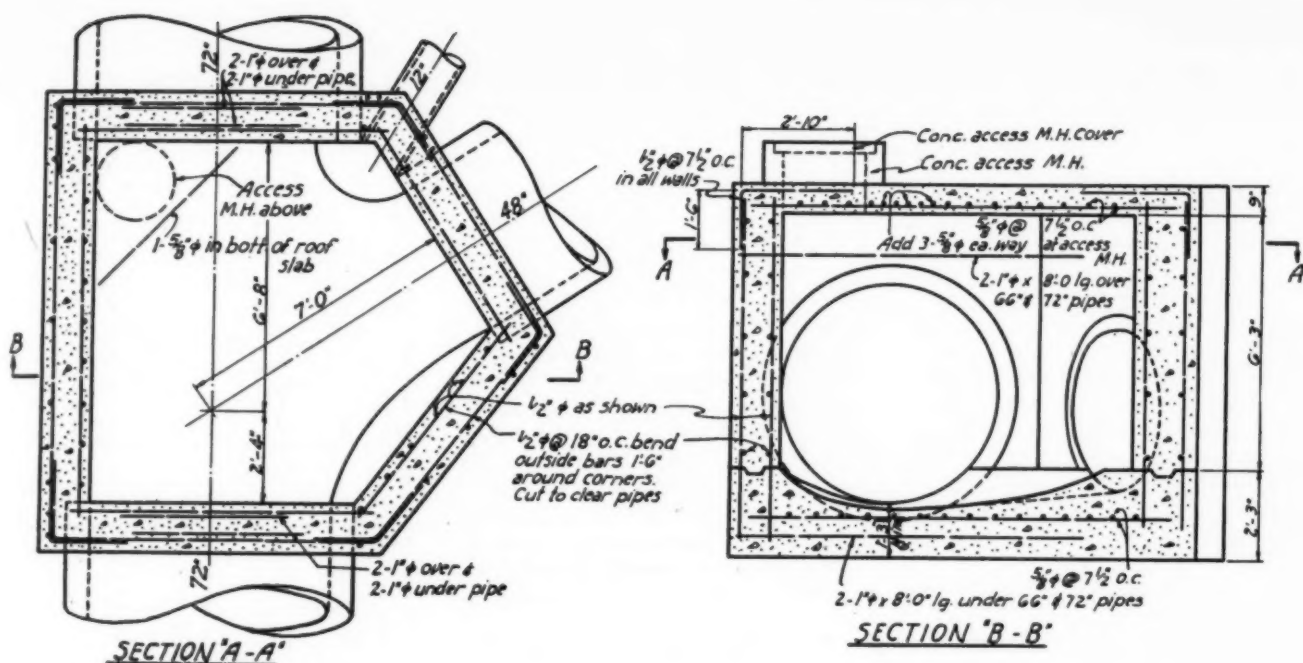
Catch Basins and Manholes

Reinforced concrete was chosen for use in all drainage structures, with manhole covers, off pavement areas, being of the same material. The design called for a structure at every change in pipe size, every change of direction, and at any location where a cleanout would facilitate maintenance. Every structure was made ample in size to accommodate maintenance personnel and equipment, and was provided with steps. Junction chambers replaced standard manholes where specially shaped structures were required to insure proper hydraulic qualities.

Catch basins were designed with steel grates 2½ ft. wide by from 6 to 10 ft. long. These structures were lo-



★ Fig. 5. Cross-section—single-barrel sewer (13'-0" x 6'-6")



★ Fig. 6. Typical junction chamber

cated in the pavement gutter about 400 ft. apart and 40 and 20 ft. off the edges of the runways and taxiways, respectively. A light type of pavement was used to carry the water from the runway and taxiway pavement to the storm drain inlets. The gutter was sloped upward each way from the catch basin to a peak of 0.60 ft. above the grate at the midpoint between basins.

A short spur of pipe, to provide a connection for future installations, was run out from drainage structures where required. The spur pipes were plugged pending such time as they are put into use.

The floors of all structures were sloped and shaped wherever required to reduce turbulence to a minimum.

70,000 Ft. of Pipe

Scuppers equipped with subway grating covers, set flush with the finished pavement, were used to collect water in apron areas. The scuppers of reinforced concrete were cast in place in 75-ft. lengths. Plastic cement, cork, and dowels were used at expansion joints. Flow-line fall was provided by varying the depth of the scupper.

About 70,000 lin. ft. of pipe, ranging in size from 8 to 72 in., was laid to provide drainage for the first set of three runways and apron. Three times this amount will eventually be needed.

All of the larger sizes of pipe were of concrete. Asbestos-cement pipe was found to be economical for the 8 and 10 in. sizes. The contractor was allowed option as to type of pipe, which resulted in all types being installed.

Porous concrete pipe was used exclusively for sub-drains and vitrified pipe for sanitary sewers.

All larger size pipes were laid on a concrete cradle. Piling was installed wherever required to supply a firm support for the cradles. Smaller size pipes were not laid on cradles unless unusual footing conditions were encountered, or unless underneath paved areas.

Most pipe used was self-centering, but where other types were installed, care was taken to insure that each joint was carefully fitted. Flow lines were kept clean. All joints in concrete pipe were sealed with a rubber compound the consistency of which is governed by the amount of slate which is added. This material selected (Durex) is believed to retain its plasticity for an indefinite period of time. Vitrified pipe joints were sealed by the use of self-centering tapered asphalt rings. One ring, cast around the spigot end of the pipe, was of the proper size and shape to fit snugly

into the other ring cast in the bell. The application of a solvent paint just prior to laying, fluxed the two rings into a water-tight fit. Porous pipe joints were sealed by the use of cement mortar.

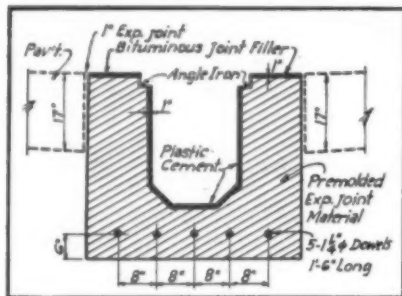
Basing their computations on the mechanical analysis of the soil, the depth of cover required to support the design load was calculated for pipe meeting the requirements of A.S.T.M. C76-41, Table 2. This was found to be 2 ft. below pavement subgrade. No actual field loading tests were considered necessary to check the computations.

Large Box Sewers

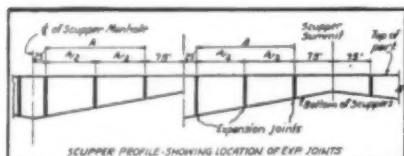
Two large box sewers built for the purpose of carrying storm water drainage from the Borough of Queens are carried along the north edge of the field into open channels. One of these, the Thurston Outfall sewer consists of 2,300 ft. of four-barrel construction, each barrel 16 ft. x 8 ft. The second one, Baisley Sewer consists of

★ Triple-barrel storm sewer outfall under construction





★ Fig. 7. Section through scupper expansion joint



★ Fig. 8. Scupper profile

7,200 ft. of three-barrel construction, each barrel $17\frac{1}{2}$ ft x 9 ft. These two sewers carry only a very small percentage of the storm water from the field itself.

For the field drainage system, concrete pipe from 8 to 72 in. is used. Where hydraulic requirements necessitated sizes larger than 72 in. pipe, box sewers of single, double and triple barrels have been designed. These box sewers range in width from 9 ft. 6 in. to 13 ft. and in height from 6 to 7 ft.

All concrete box sewers are constructed of heavily reinforced concrete, supported on piles where necessary, and have semi-rounded bottoms and keyed construction joints.

All outfalls emptied into Jamaica Bay and were, therefore, subject to tide action, and a number of them to severe wave action as well. Ten inch diameter creosoted piles, 26 ft. long, were used to support all outfalls. Additional piles, driven on a batter, were used where wave action was encoun-

tered. Piling was extended far enough inland to insure the pipe cradle or box sewer being on a firm support. An outfall manhole was installed on each pipe line at the point where these piles started. Mean low water was chosen as the outfall flow-line elevation in all cases.

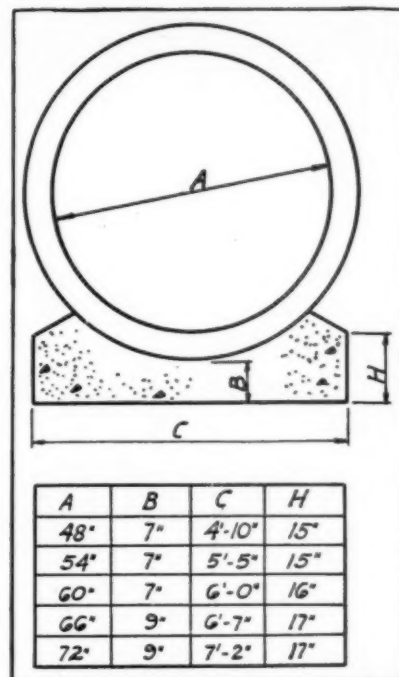
Round iron tie rods, 1 in. in diameter, and spaced on $4\frac{1}{2}$ ft. centers, were used to fasten all pipe outfalls to the cradle in locations where wave action could possibly displace the pipe.

Riprap, 2 ft. thick, was placed 8 ft. wide along the sides of the box-sewer outfalls and 16 ft. wide as an apron along the front. A cut-off wall of 3 in. sheeting was driven along the end of each box-sewer outfall prior to placing riprap. Neither sheeting nor riprap was used at pipe outfalls.

Subsurface System Required

A subsurface drainage system was considered necessary in order to meet the criterion set up requiring the ground water level be kept below frost line in all pavement areas. The data acquired from the Horner test wells were used to determine the volume of water to be handled and depth at which the pipe should be installed.

The engineers realized that the fine sand required careful treatment to prevent its being carried into the system where it could cause clogging and possible cave-ins. The design of the subsurface system, particularly the filter material, was decided on after very careful study. In determining the gradation of the filter material, the method developed by the U. S. Engineers in their Vicksburg studies was used. As is shown in Fig. 2, four was adopted as being the proper ratio of 15% size filter material to 85% size base material for use with porous concrete pipe. Since open-joint vitrified clay pipe was included as an alternate to porous pipe, the engineers

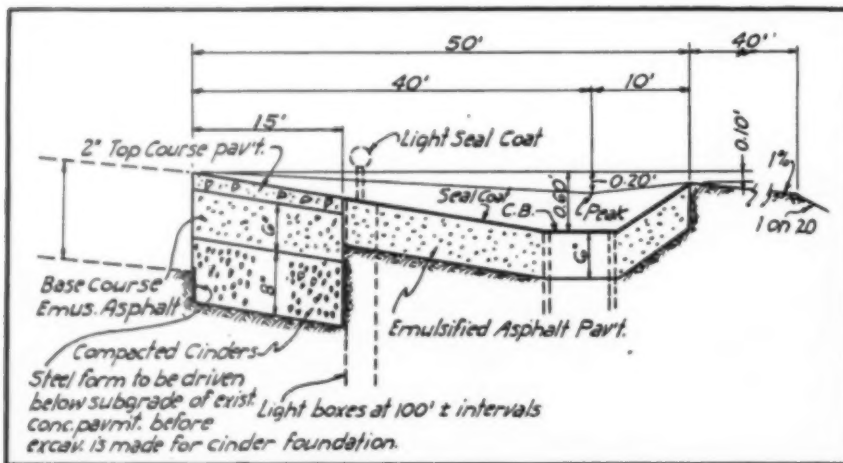


★ Fig. 10. Typical single pipe cradle

figured another gradation for material surrounding the vitrified pipe. It was intended that this material be placed next to the vitrified pipe to prevent the filter material from washing into the system through the open joints. Since porous concrete pipe was bid at the lower price, the second gradation was not required.

Novel Method Saves Pipe

Fig. 4 illustrates the novel method which the engineers developed for collecting and removing subsurface water. It will be noted that both surface and subsurface water are carried in the same system through the ingenious use of sand traps and backwater gates. Small-diameter, porous-concrete pipe for collecting water proved feasible because the water could be emptied into the closed system as often as found necessary. The backwater gates eliminated the controversial objection to combining surface and subsurface systems. The gates were installed to prevent water, under a head during storm conditions, from possibly being forced into the subgrade by reversing the flow in the porous pipe. The economy which resulted from keeping all subsurface-system pipe sizes down to 8 or 10 in. can readily be appreciated. It will be noted that the size of the sand traps allows easy inspection and maintenance. Fig. 3 shows the relative position of the two pipes and the added filter material used where the impervious marsh mat restricted the flow of water from one side of the pipe to the other.



★ Fig. 9. Typical runway shoulder section

The portion of the system which has been placed in operation to date indicates that the system functions well in de-watering the subgrade and that the small amount of sand entering the system is easily handled by the sand traps.

Gull and DeFelice, Contractors

On the basis of the lowest competitive bids received, the contracts including the drainage work for the three runways were awarded to Gull and DeFelice, of Brooklyn, in the amounts of \$2,345,085 and \$1,896,951. Work was commenced in May, 1945, and will be essentially completed early in 1946. The contractor employed a large assortment of modern equipment in order to overcome construction difficulties and to keep up with the construction schedule called for. The work was efficiently organized and skillfully handled under the supervision of the contractor's superintendents, Fred Sebastian and Ralph DeFelice.

Well Points Proved Life Savers

Well points were used to such good advantage that the water-laden sand was de-watered to an extent where normal trenching operations were possible. As is shown in the accompanying photographs, one line of well points sufficed and only every third hole needed to be used. The points were jetted into place and later pulled out by a crane.

Well points manufactured by each of the following three companies were used: Moretrench Corporation; Complete Machinery Company; Griffin Wellpoint Corporation.

Construction Methods

Clamshell buckets and cranes were used to excavate and backfill all large trenches. Excavated material was deposited well back from the ditch to allow working space and lessen the possibility of cave-ins. The same cranes were used in pipe-laying operations.

Backhoes and trenching machines were employed for smaller trenches. Bulldozers were used to advantage for backfilling and leveling.

Concrete work was formed in place and cast from transit-mix trucks.

E. J. Carrillo and M. T. Decker, firm members, shared with Horner and Shifrin the responsibility for accomplishing the drainage of Idlewild Airport. Mr. Decker, assisted by R. T. Miles, Chief Draftsman, prepared the plans and specifications. Mr. Carrillo acting in the capacity of construction engineer and general manager, was assisted by A. C. Perkins, A. F. Rogers, and Homer Amsler in inspection of materials and construction.

Federal Airport Program

Soon, maybe; details of latest version of Federal-aid airport bill slated for early passage

THE House branch of Congress has passed the Federal Airport Act at this writing, and since approval by the Senate is looked for without amendments, the nation may have an airport program by the time this appears in print.

Amount of Aid—The Act, as outlined by W. R. Macatee of the American Road Builders' Association, provides that \$500,000,000 shall be authorized for Federal-aid for airport development in the states, to be spent over a 7-year period beginning July 1, 1946. The maximum yearly amount is set at \$100,000,000. Planning, research and administrative expenses shall not exceed 5% or not less than \$3,500,000 yearly; and shall be deducted from appropriations before apportionments are made to the states. In addition, \$20,000,000 is authorized over a 7-year period for Alaska (\$10 million) and Hawaii and Puerto Rico (\$5 million each). This, too, is subject to 5% reduction for planning, research and administrative expenses. No yearly ceiling is imposed respecting funds for these areas.

"75-25" Compromise

Apportionment Basis—Seventy-five per cent of Federal-aid to the states will be apportioned on basis of one-half in the proportion which a state's population bears to the total population of all states, and one-half in the proportion which a state's area bears to the total area of all states.

Twenty-five per cent of appropriations shall constitute a discretionary fund, to be apportioned by CAA's Administrator in a manner he may deem most appropriate for carrying out the National Airport Plan, regardless of states in which projects are located. Portions of this fund may be used for assisting in airport development in national parks. The proposed appropriations would be subject to 5% reduction for planning, research and administrative expenses, leaving a \$475,000,000 construction fund. The discretionary fund would amount to \$118,750,000, leaving a net balance of \$356,250,000 for formula apportionment. The state apportionments are listed in the accompanying table.

50-50 Aid Provided—Federal-aid

for development of Class III or smaller airports in the states, Hawaii and Puerto Rico shall be 50% of the allowable costs of the project. Larger projects may receive an amount deemed appropriate to the Administrator, not to exceed 50% of the allowable costs. States containing public and non-taxable Indian lands shall be granted additional Federal grants in proportion to area such lands bear to the state's total area, but not to exceed 25%. Federal-aid funds for airport development in Alaska may be spent on projects on varying matching-basis, subject to the Administrator's judgment, and ranging from a 50/50 basis, and up to 75% of allowable costs.

Who Can Apply—Any public agency, or two or more acting jointly, may submit a project application. In many cases communities will likely act jointly with their state aviation authority, especially in those states where state-aid will be granted. Otherwise, state aviation authorities would not be likely to grant financial aid except and unless project applications and Federal grants are channelled through such authorities.

No municipality may submit a project application which is subject to the laws of any state if application by such a municipality, or other public agency is prohibited by the laws of such state. All projects are subject to approval by CAA's Administrator. Project applications are subject to public hearings.

Program Reviewed Annually

Project Review—CAA's Administrator is required to revise the National Airport Plan yearly, and submit it to Congress. In this way Congress will be kept fully informed concerning the changing needs for airports in different localities, and CAA's Administrator and Congress thus keep abreast of such changes as may occur from year to year. Federal-aid shall apply only to projects included in the then current National Airport Plan.

Before the close of each fiscal year the Administrator is required to submit to Congress a list of Class IV and larger airports on which authority is sought for construction to be undertaken in the following year. The

recommendation which the Administrator makes with respect thereto, and the estimated amount of Federal funds therefor, will be subject to consideration and approval by Congress.

Project Requirements—Sponsors of projects are required to assure the Administrator in writing, that—

(1) the airport will be available for public use; (2) it will be suitably operated and maintained; (3) the aerial approaches will be adequately cleared; (4) the airport will be available to U. S. naval and military aircraft without charge, except a reasonable proportional share of ordinary costs; (5) space will be made available to U. S. for weather-reporting activities, etc.; (6) accounts and records will be kept in accordance with standards prescribed by CAA; (7) airport operators will submit annual or special reports to Administrator; (8) airport records will be available for inspection by CAA.

Aid on Land Purchase—Federal-aid applies to land-costs and easements in air space in developing a Class III or smaller airports; this shall be 25% of the allowable costs of such land and easement. In the case of larger airports, the Federal portion shall not exceed 25% of such costs.

Allowable costs in which Federal-aid may participate include those incurred subsequent to enactment of the Act; also planning expenses and expenses for acquiring land which would not have been incurred otherwise, but which may have been incurred before enactment of the Act. The Administrator of CAA has broad powers in determining allowable costs, which must be reasonable in all cases. Expense of constructing administrative buildings, but not hangars, is considered an allowable cost in which Federal-aid may participate.

Where contract work is done on airports, (a) convicts may not be employed; (b) veterans shall be given preference in employment, except in executive, administrative and supervisory positions; (c) minimum wage rates to be established by the Secretary of Labor shall prevail.

Other Features

The Administrator of CAA shall consider, and report to Congress claims by public agencies for damages that might be made to airports by any Federal agency. Payments for such damage may be made, but only on approval of claims by Congress. Ordinary claims shall be filed within six months after occurrence of the damage. Claims for damages caused by military operations during

Apportionment of Federal-aid, National Airport Plan

| State | Apportionment |
|----------------|---------------|
| Alabama | \$ 6,893,546 |
| Arizona | 7,392,232 |
| Arkansas | 5,780,169 |
| California | 18,744,576 |
| Colorado | 7,671,269 |
| Connecticut | 2,619,216 |
| Delaware | 433,590 |
| Florida | 6,031,179 |
| Georgia | 7,717,176 |
| Idaho | 5,638,213 |
| Illinois | 14,061,652 |
| Indiana | 6,799,533 |
| Iowa | 6,768,153 |
| Kansas | 7,297,865 |
| Kentucky | 6,249,852 |
| Louisiana | 6,073,872 |
| Maine | 3,109,525 |
| Maryland | 3,099,660 |
| Massachusetts | 6,355,949 |
| Michigan | 10,577,613 |
| Minnesota | 8,751,281 |
| Mississippi | 5,781,455 |
| Missouri | 9,252,235 |
| Montana | 9,432,479 |
| Nebraska | 6,341,180 |
| Nevada | 6,664,746 |
| New Hampshire | 1,216,654 |
| New Jersey | 6,118,274 |
| New Mexico | 7,893,672 |
| New York | 21,249,005 |
| North Carolina | 7,962,888 |
| North Dakota | 5,037,571 |
| Ohio | 11,821,546 |
| Oklahoma | 7,297,561 |
| Oregon | 7,197,335 |
| Pennsylvania | 16,132,735 |
| Rhode Island | 1,041,463 |
| South Carolina | 4,413,380 |
| South Dakota | 5,415,098 |
| Tennessee | 6,454,411 |
| Texas | 24,478,073 |
| Utah | 5,752,896 |
| Vermont | 1,054,757 |
| Virginia | 6,046,350 |
| Washington | 6,379,645 |
| West Virginia | 4,011,198 |
| Wisconsin | 7,575,602 |
| Wyoming | 6,111,640 |
| Total | \$356,250,000 |

war shall be filed within 60 days after the termination of the war.

The Act omits provisions by which the Administrator of CAA would be authorized to acquire land or interest in air space by condemnation on behalf of project sponsors in connection with an airport development project. In certain cases, government owned land, which is necessary for the operation of a public airport, may be conveyed to the public agency sponsoring the project.

The pattern of civil airport construction will follow general and basic engineering principles established by the Civil Aeronautics Administration. Nevertheless, the services of many competent private engineers will be required to prepare and execute detailed plans for the design, construction, and maintenance of civil airfields.

With final passage of the Federal-aid Airport Bill imminent, an airport construction program estimated at \$300,000,000 yearly seems assured, made up of:

| | Per Year |
|---|---------------|
| Federal Aid Funds | \$100,000,000 |
| Matching Funds | 100,000,000 |
| Estimated Added Funds by Municipalities | 100,000,000 |
| Total | \$300,000,000 |

The Civilian Production Administration has issued a stop order against many forms of construction, including airports. However, con-

struction of other transportation facilities may be carried on and it is possible that airports may be exempted from terms of the order, as was done in case of roads, pipelines and railroads. In any event, construction of forbidden types of work may get approval by Regional CPA officials certifying to their essentiality.

Bridges up, Grading Down, in Michigan Bids

Walter Toebe, executive secretary of the Michigan Road Builders' Association, writing in "Michigan Contractor and Builder," made the following comments to contractors regarding low bids at the first postwar highway letting:

"The long awaited first letting of the postwar highway program was held in Lansing on March 20, 1946. There was considerable interest in this letting as to the trend in prices. A rumor had been going around that the Public Roads Administration would approve only such work on which the price increase amounted to 35% or less over comparable jobs in 1941. This was not entirely true, however.

"Studying the list of jobs, we find that the five jobs as a group were estimated to cost \$600,000. Adding up the low bids, we find a total of \$598,248.83, and so as a group the bids stayed within the Highway Department's estimate. Taking the jobs separately, however, we find that the price on structures was increased while that of the grading or road jobs went for less than the estimate. This is due to the fact that very little material such as lumber, hardware, etc., is used on a road job, especially a grading job, while those items and many others are a sizable factor in bridges. This proves that a flat percentage rate on highway construction does not mean a thing unless you analyze the job involved. In general, we feel that the Highway Department and the Public Roads Administration can be well satisfied with the bids they received at this letting. Construction work, be it state or private, will cost more and more as the prices of material and labor increase. This rule applies to practically any other business, OPA notwithstanding."

5-Year Road Program for Peru—A 5-year road building program will be started in Peru in August. The total expenditure for the period is estimated to be \$60,000,000. Of this amount 15 to 20 per cent will be expended abroad for materials and equipment.

★ 25-Year Men, Congratulations!

Our congratulations and continued best wishes to the veteran highway leaders honored at the recent AASHO Convention.

This editor cannot refrain from making several comments on the occasion of this first annual 25-year award of merit ceremony. One is that the reason we have the greatest highway system on earth here in the U.S., lies largely in the existence of this remarkable reservoir of experience and "know how." Of course, many men of outstanding leadership are not included here for obvious reasons. We're thinking of their contribution, too.

Our chief observation is the disparity of representation between the states. Six states reported no 25-year men. Nine named three or less. Only 19 states could list more than seven. Illinois came first,

with 22 veterans, most of whom began right after World War I. Massachusetts, Tennessee, Texas, Virginia, New York and Maryland are next, in that order.

The Public Roads Administration's 99 names bespeak the stability which that organization has enjoyed.

Another point is in the form of a question. What of the rank and file? It is our understanding that this award is made only to men in executive positions. We'd be interested in knowing how many other worthy employes have found such long and steady tenure in our highway departments although not of top executive rank. In many states it has been said that the top jobs are "sewed up" so thoroughly due to the seniority system that able young men have left subordinate positions for other jobs.

★ Airports Another Jurisdictional Dispute

Much has been said recently about aviation and the part it is destined to play in our national economy. Predictions vary somewhat as to the number of new jobs involved and the volume of business to be expected. The experts, however, do agree that regardless of the improvement in aircraft, aviation cannot assume its rightful place of importance until ground facilities, adequate in both size and number, are provided.

The hub of the ground facilities in every case is the airport. C.A.A. has given congress a comprehensive plan for the development of the nation's airports. The house and senate have each passed its own version of a bill to put airport development on the same Federal-aid basis that has worked so well with our national highways. So far so good, but after several months, the house and the senate have been unable to compromise their differences, so a stalemate exists. The entire difference lies in the extent to which the money will be controlled by the cities or by the states. The situation deserves about as much sympathy as does any one of the jurisdictional disputes which end up in a strike affecting the well-being of large numbers of innocent citizens.

Both factions have pressure groups at work and no doubt there is merit to both sides of the argument. It is difficult, however, to see a particle of merit in letting the thing drag out until it is too late to get anything done during the 1946 construction season. It is too late now to salvage all of the good weather.

The uncertainty of the situation not only holds up the general airport program but also makes public and private agencies hesitant to go ahead spending their own money. They are afraid the final version of the bill may result in any action they take now later proving to be unwarranted economically or else at cross purposes with the over-all scheme. C.A.A. is losing the services of many of its trained engineers because it lacks airport funds.

We certainly hate to see the airport program added to the list of postwar disappointments. The list has already assumed alarming proportions. We cannot see the necessity for it. With so much of the work still in the planning stage, we hope Congress can soon find an acceptable compromise and let the engineers and contractors get their part of the work done so that aviation can have a chance to fulfill its promise of better things to come.



★ A 16-yd. heap load in 37 sec., said the stop-watch as this snapshot was taken on Nello Teer's job. Equipment on the project furnished by Central Engineering & Contracting Corp., Durham, N. C. Note smoothly bladed path ahead of the wagons

Loader & Wagons

move 700 cu. yd. per hour on fast moving Virginia grading job

Tractor-drawn scrapers handling preliminary and short-haul yardage while loader helps clock notable production on Shirley Memorial Highway; Nello L. Teer Co., 1,200,000 cu. yd. grading contract

MODERN big-capacity earth-moving equipment is again demonstrating its speed on highway work, this time on the current Shirley Memorial Highway extension near Washington, D. C. The Virginia state highway department recently let nine intermittent sections, totaling six of 14 miles of extension for this 4-lane divided highway into the nation's capital.

Nello L. Teer Co. of Durham, N. Carolina, was low bidder, their principal bid item being 28c for 1,200,000 cu. yd. of sandy clay in rolling terrain.

Clearing of small to medium trees and brush was completed last winter with bulldozers assisted by crawler cranes equipped with grab hooks for piling debris for burning. The same cranes trenched for culverts and set large concrete pipe.

In view of the sandy clay and gravelly material, wide grade and long cuts, it was expected that this

well known firm of contractors would put on a good performance, weather permitting, and he is certainly doing so at last report. In the wake of the culvert crew tractor-drawn scrapers scalped the rough ground, took first leveling passes in the cuts, and filled holes in the ravines, in preparation for a second outfit consisting of a heavy-duty loader and bottom dump wagons. The scrapers also took some shorter cuts all the way down. The scraper group consisted of four 15-yd. units, two heavy pushers, four angle-dozer for spreading, and one sheeps-foot roller, with two triple-drum units in tandem.

Loader Operation

The loader being used is a heavy-duty, tractor-drawn unit with elevator belt. This earth-loading tool is a relatively new product, but previous units have turned out an impressive yardage during and since the war on

a number of large projects. The contractor first tackled a 79,000 cu. yd. cut about 800 ft. long and 100 ft. base width. Ten 16-yd. bottom-dump wagons (heaped capacity) were put on the job, but only six were used for this cut. The loader outfit works the outside edges of cuts in one round trip, or circles from the center of the cut to the outside, depending on the progress of the rooter and of the needs of the moment in keeping the contour of the cut dressed as work progressed.

A stop-watch check on the above initial cut showed that this loader heaped a wagon in from 35 to 42 seconds. The quantity loaded averaged 11.5 cu. yd. bank measure, bulked to about 16 yd. in the wagon. The haul averaged about 1000 ft. and the loader moved about 7,000 cu. yd. per 10-hr. day in steady going.

Nello L. Teer Company is putting on a fine performance of teamwork on the project. Although their bottom-dump operators have had no previous experience with the loader, these fellows are spotting their units

quickly, getting a capacity load and pulling away in a minute or less.

Two grader operators staying close together keep ruts ironed out, thus speeding up hauling and general efficiency. The soil can be peeled up without a roter, but the steady use of a roter with two teeth in advance of the loader is adding probably 10% to 20% to the daily output.

Keep Cuts Dressed

Instantly noticeable on this job as on all of the Teer contracts, is the skillful way in which working areas are kept carefully crowned both longitudinally and transversely through cuts, and smoothed out at all times, so that sudden or overnight rainfall will drain off quickly with minimum wetting of the soil. The value of this policy has been demonstrated by the fact that following an ordinary rainy night, the outfit is usually able to get going with only an hour or two of delay and with minimum trouble over moisture in excess of optimum.

The filling procedure also follows approved practice, in that bottom dumps are unloaded on a downhill drag whenever possible. Two bulldozers, operated in pairs, work forward and backward without turning around to keep dumped material well spread. A 6-drum sheepsfoot unit passes down-hill over the freshly placed loose material, and returns over compacted ground to conserve power. Dump wagons, after discharging, re-cross the fill in a well-compacted path, to save power and use of low gear.

Compaction obtained is considerably in excess of the 95% required, soil density usually running to 105 lb. per cu. ft. or more. The visitor is quick to observe that a great deal of the compaction is accomplished by the rubber tires of the wagons or scrapers. A smooth tandem roller



★ A pair of heavy graders is making a full time job of keeping cuts smoothly bladed. Saves on hauling, and assures good drainage of the cut working area. Good surface drainage



★ (Left): W. R. Burton, supt. and J. W. Hanner, engr. for Nello L. Teer. (Right): Gallery on the Teer job: Everett Armington, sales manager; Everett Delen of Atlanta, with Euclid Road Machinery Company; Mr. McAlpin, an English contractor visiting America; Nello Teer, contractor; H. W. Hiscox, Euclid.

originally employed was found unnecessary for most of the work.

W. R. Burton is superintendent for Nello L. Teer Co., and J. W. Hanner, engineer. W. F. Smith is resident engineer for the Virginia state department of highways.

[See page 115 for additional photos taken on this project.]

Contracts Let for 503 Highway Projects—During January and February the state highway departments and the District of Columbia awarded contracts for 503 highway projects that will cost \$54,600,000. Of this number, 299 were Federal-aid projects involving improvements on 1,567 miles of roadway, at a cost of \$47,653,500.

★ (Left): Bottom-dumps unloading downhill. The sheepsfoot rollers also work downhill over soft ground

★ (Right): Note how dump wagons climb out of the filled area over a well compacted haul path, which changes from hour to hour



Research Board Meeting

Traffic planning, parking and other urban problems competed with physical topics such as joint design. Excerpts from some of the many papers and discussion notes from the Highway Research Board's recent annual meeting at Oklahoma City

RAFFIC and functional considerations received marked attention at the Highway Research Board's Oklahoma City meeting, Jan. 26-28, 1946. Urban problems particularly, such as parking and expressway development in relation to mass transportation, held the stage for a time.

Yet physical research in soils and pavements remains the first love of highway engineers, and even the local newspapers speculated on the enthusiasm of those "technical experts" who, it was rumored, sat in meeting until 11:50 p.m., Saturday night, drew diagrams on breakfast tablecloths Sunday morning, and met again all day. All of which they did, so help us.

The Board's Correlation and Publishing Program

In his annual report, Director Roy W. Crum outlined the organization's postwar plan of operation, which puts greater emphasis on group action and correlation of research activities. The present plan includes:

1. A staff of engineers and other technologists who will travel and maintain contacts.
2. An enlarged publication program comprising the Board's annual proceedings, its abstracts, a series of bulletins reporting on concluded researches, a current Road Problems series of bulletins similar to the popular Wartime Road Problems series, and miscellaneous bulletins.
3. More and larger committee meetings.

Mr. Crum stated the Board's chief problem which is to develop a true national program of research, utilizing all available agencies and facilities and giving proper priority to urgent problems.

The Board's present headquarters staff includes Fred Burgraff, associate director in immediate charge of correlation service; George Rahn, engineer of materials; Walter Johnson, engineer of soils and foundations;

Frank Wray, engineer of design; Wainwright Bridges, administrative assistant; and Wm. N. Cory, Jr., assistant.

Herman A. MacDonald, retiring president of the highway officials, characterized the linking of AASHO, HRB and PRA in the correlation service as one of the most forward-looking steps in highway history. It will reduce duplication and conserve research manpower. More importantly it will permit a better visualization of problems on which research is most needed, a review of what is known on a given subject, the foundation of a definite research program, and a breaking of the task down into workable units.

Among the foremost fields of research are the subjects of joints in concrete pavements, factors affecting concrete pavement durability, the whole field of bituminous materials, and the effects of water on the subgrade. We do not yet know how to write a definite specification for asphalt, observed Mr. MacDonald, nor how to design bituminous mixtures scientifically. And more fundamental data are needed in relation to drainage, soil bearing power, stability of

soils or granular mixtures, compaction of fills, and the function of water in concrete making. Other major research subjects: Effects of heavy loads, erosion control, shoulder treatment, roadside planting, safety lighting and pavement markers.

A grave need is to bridge the gap between research and practice and speed up the application of new knowledge.

Following are excerpts and notes on some of the many excellent papers and committee discussions.

Transit Lines on Expressways

The importance of this subject, presented by Leslie Williams, American Transit Association, New York, is shown by the fact that most large cities have finally come to expressways, and that a single bus or electric rail car can take the place of many individual autos, thus greatly increasing the peak capacity per lane of expressway. How buses save lane width was shown by figures on Chicago's Outer Drive, which carries a peak of 3,000 passengers in 1780 vehicles per lane per hour (1.6 per car), and a peak of 7,000 passengers in all lanes. Each limited bus on the Outer Drive carries 50 or more persons, thus taking the place of some thirty vehicles.

PRA leaders have pointed out that urban highway and transit plans must not be divergent.

Origin-destination surveys in Kansas City show that public transit handles 50% of all trips to and from the downtown area. Seattle's pattern is similar—900,000 urban trips daily; 50% transit or 70-80% transit considering downtown alone. Philadelphia's daily influx of 750,000 is only 8% by auto. Limited-stop bus and in some cases rail transit facilities hence must be designed as an integral part of expressway developments; such transit also to reduce the downtown auto parking load, lessen accidents (limited buses are thirteen times safer than individual cars), and encourage



R. W. Crum

more orderly suburban development.

Present expressway and arterial street design standards are no bar, Mr. Williams pointed out. The problem is one first of policy, then design and plans for loading stations, ramps, turnouts, etc., should be developed in cooperation with the transit companies.

Discussion of this paper centered on the cost of bus loading turnouts and similar facilities, and sources of financing. A San Antonio spokesman said that three ways to reduce urban congestion are: provide more off-street parking facilities, limit on-street parking, and encourage mass transportation, through public subsidy if necessary. Buses in San Antonio use one-tenth of the streets and cause a very small fraction of the pavement wear, yet pay \$200,000 per year in franchise taxes plus \$400 daily in gasoline taxes, which is believed to be generous.

Freeway Lighting Costs

A report on lighting costs on depressed expressways was given by Burton W. Marsh, chairman, committee on highway lighting. Costs will probably range from \$7,200 to \$10,600 per mile of 4-lane depressed roadway for installation and from \$1500 to \$3500 per mile per year for operation and maintenance. These figures do not include underbridge and ramp lighting costs.

Estimates were based on various assumptions of design and intensity of illumination. Experts differ on lighting needed, the estimates ranging from 0.45 to 0.80 foot-candles or more at roadway level, the latter being favored as a minimum by the committee. This lengthy report gave data for types of lamps and luminaries, mounting height, spacing, pole location and other details; also covered feasible methods of dividing lighting costs between the utility and public agencies.

Of interest is the statement that extensive research has found little difference in visibility between filament, sodium and mercury type lamps.

Parking Needs Far-reaching Study

Parking is an integral part of the urban congestion problem, and often a bottleneck in expressway design, and must be given increased attention and analysis, it was noted in an all-afternoon symposium on the subject. Participants included Natham Cherniak, Port of New York authority; T. M. Matson (committee chairman), Yale University; Lloyd Braff, director, traffic design division, Detroit; R. A. Flynt, director of high-

We Couldn't Include 'Em All

Editor's Note—On the following pages we present an unusually complete review of the recent Research convention, followed by noteworthy comments on the program of selected states.

Our apologies to the authors of excellent papers omitted or covered inadequately in this convention review. Space limitations have made it impossible to include all 40 or so papers. For a more complete and in some cases extensive review, touching on all convention papers and committee reports, read the Highway Research Board's "Highway Research Abstracts, Convention Review" issue just published. The abstracts are available from the Board's headquarters, 2101 Constitution Avenue, in Washington, D. C., at a subscription of \$2.25 annually.

way planning, Atlanta; and F. W. Lovejoy, PRA.

Some of the facts borne out in recent research:

1. Perhaps 30% of the traffic in downtown areas consists of "cruising storage"—drivers going slowly around looking for a place to park, or killing time while waiting.

2. Amount of use of a parking facility is affected by the driver's unwillingness to walk more than a block or two to a store. Many people now stay out of congested areas for lack of parking space.

3. Home interviews in studies of traffic habits alone are not satisfactory for analyzing a downtown parking problem. They must be coordinated with spot data.

Parking problems can be solved through origin and destination studies, stated a Report of the Board's Committee on Parking, T. M. Matson of Yale University, chairman, and S. T. Hitchcock of PRA, secretary. Parking habits are complicated by the human equation. Especially complex are drivers' motives in entering a downtown area. Serious planning and systematic provision of parking facilities by engineers are hampered by an apathy on the part of the public. Local responsibility must be definitely assigned, and a real solution requires long-term research to determine best locations and ultimate capacity of parking space. Techniques for mak-

ing such studies must first be developed and appraised, and data ultimately sought must help decide how much floor space is needed; relative parking efficiency of different types of facilities; price schedules that traffic will bear; distance users are willing to walk to reach offices or stores, etc.

The committee on parking plans to work on "before and after" studies in connection with parking programs in Kansas City and elsewhere.

Flexible Pavement Design

The need to further analyze the mechanics of wheel loads as they affect subgrades was stressed by M. S. Kersten, University of Minnesota. In a paper on methods of measuring the strength of subgrade soils, he observed that 22 methods of flexible pavement design have been proposed, but the main fact remains that you can't get a soil to take a load beyond its capacity.

A large number of the methods specify a plate bearing test for the subgrade test; several advocate a tri-axial compression or some type of shear test; in two a penetration test is used. Two of the methods merely give the range of support values for use with certain types of soils and in some of the methods the means of strength determination is not specified. It would be desirable to know the exact manner in which a subgrade soil acts in supporting wheel loads so that a strength test could be selected which would measure the property of the soil which is most effective in this support.

Subgrade Support

A progress report on methods subgrade preparation for strength was read by W. H. Campen, Omaha Testing Laboratories. Engineers should review all construction procedures by which the inherent bearing value of soils may be developed to the fullest degree, with a view of perfecting new and better equipment if possible. In reviewing fundamentals he observed that soil mixtures can be rendered more or less stable by densification; the strength of a soil is governed by its dry bulk density, which in turn limits water content; before the strength possibilities of a subgrade can be determined, its water capacity must be known. And obtaining a given load capacity depends on preparation of the underlying subgrade, selection of materials, water control, and compactive effort. Praise was given to the progress made in development and use of mechanical pulverizers to more thoroughly disintegrate and mix sand-clay and other stabilization mixtures.

Accurate addition of moisture in

processing has been accomplished during travel-plant operation, but stationary mixing methods are preferred by this authority as giving best control.

Mr. Campen noted in connection with the demands for increased density that some plastic soils simply cannot be compacted to 95% density. Ordinary fine grain plastic soils can be compacted to 95% easily, but to 100% with some difficulty. Better equipment procedures in compaction are still needed, but he urged that measured subgrade strength with a given soil or mixture should be used as a basis of road design, rather than the compactive effort.

"Curing" Compacted Soils

More effective compaction equipment is needed for plastic soils, or better ways of utilizing present equipment. So-called curing of compacted soils has proved very beneficial: first rolling with a sheep's foot, then allowing the slight excess of water to evaporate while rolling each lift further with a pneumatic roller. This procedure takes time, but is economical and productive of very high densities. Extreme surface densities are obtained when a smooth roller is used in conjunction.

As to density tests, he recommended continued use of the standard sand test. In testing granular material he observed that tests based on minus-4 material, as commonly practiced, sometimes result in lower actual densities than needed. Moisture-density should be run on the entire sample, or a correction factor used.

Mr. Campen urged a more systematic study of subgrade failures, which are due to unforeseen loads, insufficient densification, allowing infiltration, or a combination. Specifically he suggested greater use of soil survey data, mechanical mixing, more attention to drainage, and insistence upon greater density, greater thickness or both. Some kind of soil strength index should be the basis for design, and the industry needs to develop some kind of a single pass method of mixing and compacting the soil. Low air voids is a criterion in measuring water resistance. Engineer and contractor personnel need to know more about the whole subject of compaction and soils.

Traffic Compaction. In discussion C. A. Hogentogler called attention to the fact that traffic is an excellent and economical means of compaction, vital to low-cost road construction, and that some soils need deep compaction. He advocated letting traf-

fic in for a year before final surfacing of such roads.

Group Index Advocated

Mr. Campen read another paper, "Density of Soil Mixtures as a Criterion for Strength." A wide variation in strengths is being obtained by standard methods of density control. A group index based on several factors was suggested as the basis for determining design thickness. C. A. Hogentogler in discussion characterized the group index an important development. He also quoted Prof. Terzaghi on the fundamental that final determination of pavement thickness must be governed by experience with pavements in the locality; field investigation of completed pavements is the only answer.

Mention was made of a formula for the subbase thickness required under flexible pavements. This formula was developed on the west coast by Don Steel of PRA and is based on the liquid limit, plastic index, and material passing 200. Dating from 1938, this index is not just an evaluation factor but a method of checking thickness.

Subgrade Moisture Control

That a high degree of saturation is widely prevalent in many clay and silty clay subgrades was noted by M. G. Spangler, Iowa State College,

Research Board Awards

The 1946 Annual Award for the most outstanding paper of the previous year (convention not convened in 1945) went to Donald W. Loutzenheiser, Public Roads Administration, Washington, D. C., for his presentation, "Proposed Design Standards for Interregional Highways." [See elsewhere in this issue an article by this author written especially for **ROADS AND STREETS**.]

The 16th annual Bartlett Award for distinguished service to the highway profession was given to Fred E. Everett, New Hampshire Commissioner of Highways, since 1915. George Henderson of Rhode Island made the presentation. Mr. Everett has served his state since 1906, and has long been a leader in national highway affairs.

An unforgettable eulogy on the life of George H. Bartlett, in whose honor the Bartlett Award was founded, was given by his long-time friend Frank T. Sheets, president of the Portland Cement Association.

in a paper on problems in subgrade moisture control. But there are exceptions. Present pavement design tendency is to assume that the subgrade moisture will be high in all but coarse gravelly soils, and such designs are often wastefully strong. There is need for more accurate prediction of the terminal moisture content under a relatively impervious pavement. The problem can be approached by a study of capillary potential. The so-called Buckingham capillary potential concept, involving the equilibrium phase of unsaturated soil, holds promise.

Installation of automatic devices for collection of data on subgrade moisture, to aid long-time studies, was suggested by M. G. Spangler.

Highway Drainage

A plea for better stream flow and flood data to aid in the design of drainage structures for highways and flight strips, was embodied in a report of the Committee on Surface Drainage of Highways, by Carl Izard, PRA. The big question everywhere still is, what quantity of flow? It is hoped that the U. S. Geological Survey and the Weather Bureau will ask for funds for gathering and analyzing hydrographic data in representative small water sheds.

Street Inlet Design

Design and capacity of gutter inlets were covered in a paper prepared by N. W. Conner, of the N. Carolina state college and delivered by W. S. Winslow. It reviewed test data on experimental inlets installed at Raleigh, N. C., covering various lengths and shapes of throats, inclusion of deflection vanes, gutter contour, etc., and their efficiency on various gutter gradients. New paving accelerates street run-off, and city engineers often find their existing inlets to be inadequate. A study of the data shows that plain side inlets can be satisfactory even at steep grades. The effect of increasing the length is greater in the larger lengths and at the higher grades. Thus on a 2% grade, increasing the length of the inlet from 6 to 7 ft. will result in almost double the capacity of the inlet change from 1 to 2 ft.

The conclusion that the grate type of inlet is most efficient at low grades and becomes less effective at higher grades was borne out by the tests on this type.

The use of deflecting vanes to make the water flow into the side inlets proved highly satisfactory. Deflecting vanes proved highly efficient on steep grades, adding 460% to the

inflow of a 2-ft.-wide side inlet in the case of a 10% grade.

Expansion Joint Study

A progress review of a long-time study in the measurement of expansion joint movement was given by R. A. Moyer, research professor of highway engineering, Iowa State College. Covering eleven years, a watch on this test section has revealed a gradual opening up of contraction joints and progressive closure of expansion joints (0.3 in. average closure of original 1-in. joints spaced at 60-ft. intervals). The greatest progressive closure has occurred with sponge rubber and poured asphalt joints; the least with premoulded joints. The poured joints no longer open enough to function properly.

Investigational Concrete Pavements

A panel discussion was held on concrete test sections which were built by six states in 1941 under PRA sponsorship, as a long-time study of joints. While considerable detail was touched on, it was felt that no conclusions can be made for some time.

Materials and Construction Committee Session

Many problems were touched on briefly at a meeting of the committee on materials and construction, Prof. C. H. Scholer presiding. Some of the points covered:

Poured Joints: Control of heating temperature of filler is still a problem out on maintenance work . . . the needs vary regionally, depending in part on annual temperature range, which may be as little as 30° F. or as much as 125° F. in various states . . . some engineers don't like to spend money on the best joint filler, but pay more in maintenance and replacement due to false idea of economy, observed one delegate . . . in pouring rubber joint compound it is important to have the area free of laitance, so compound will stick . . . several new rubber joint materials on market . . . joint maintenance is an economic problem of tremendous importance; big job is to replace the thousands of miles of old joints, getting pockets sufficiently clean in the process . . . need for faster, cheaper, labor-saving method of joint clean-out and refilling is a challenge to engineers and equipment manufacturers; possibly the need is for a method of filling cracks from the bottom up . . . joint design will progress only through greater cooperation between design, materials

Other Paper and Committee Report Highlights

Dowels must be closely spaced in paving joints, if slab edges are to be adequately protected, according to graphs under the Westergaard analysis, made in a study by L. W. Teller, principal engineer of tests, PRA.

Overlays or rigid airfield pavements, placed as reinforcement where the original concrete is too thin for 60,000-lb. wheel loads, are feasible according to traffic tests by army engineers. Data on various thicknesses and types of overlays not yet conclusive. Reported by Herman L. Gaines.

Flexible pavements design criteria for 300,000 lb. planes with single tires was studied under accelerated traffic tests at Stockton, Calif. This army project included asphaltic concrete pavement sections from 2 to 16 in. thick on low value clay soil and crushed rock base. Reported by R. A. Freeman, U. S. Engineers, and O. J. Porter, California.

Aerial surveys to identify granular deposits was the subject of a paper by Robert E. Frost, Purdue University.

Blowups and their correlation with source of coarse aggregate was covered by K. B. Woods and N. E. Sweet, Purdue University, and T. E. Shelburne, Virginia. Two thousand six hundred and twenty-three miles of concrete pavement without expansion joints have had 2,404 blowups. These occurrences varied greatly on different sections, and a definite correlation with coarse aggregate was shown.

Roadside development. The committee report by H. E. Neal, Ohio, said that the big job ahead is to provide better road shoulders with adequate width, surface and load bearing strength. Extensive research is needed. The turf surface should be designed as a single unit of construction with base and sometimes subbase of selected materials. Especially important is a ditch of one inch per foot to assure quick run-off of water from the pavement.

Origin-Destination Survey Techniques

A committee report by D. Grant Mickle and John T. Lynch touched on surveys in 37 metropolitan areas, involving methods of interviewing motorists, etc. Trips of vehicles on other than to-work trips have been difficult to measure accurately by sampling methods, and a factor has been added to the ground counts. A revised manual on this subject is to be made available to city officials.

Urban Off-Street Terminals. The powerful influence of terminal facilities on the pattern of urban highway transportation was mentioned by F. W. Lovejoy, PRA; terminals must be planned in relation to the city as a whole, downtown business, transit and bus lines and parking facilities.

Highway Capacity. Committee report by O. K. Norman, PRA. Tables and graphs were included on the maximum capacities of roads of 2 to 8 lanes, a special study of 3-lane practice showed that the average 3-lane rural highway now carries 3,200 vehicles daily. Peaks of 6,000 daily reported. Ramp and interchange capacities now being studied.

Rigid Pavement Design to eliminate pumping. The following recommendations were made in a report on the Board's project committee on maintenance of joints in concrete pavements as related to pumping action. Harold Allen, PRA, chairman.

1. That the road be designed with a high level profile.
2. That adequate subsurface and surface drainage be provided.
3. That soil surveys be made and used to determine the need for sub-grade treatment.
4. That blanket courses be used on all fine-grain soils.
5. That shoulders be constructed of low volume change soil.
6. That expansion joints be omitted or spaced at the maximum distance necessary for keeping stresses within critical limits.

and maintenance men. A project committee on crack filler is to become more active.

Premoulded Joints—South Carolina practice is to use cotton-seed hulls; Alabama, hulls and sawdust; Arizona employs redwood. Texas uses some pressed redwood, with end fibres ver-

tical and wood compressed to 50% thickness initially and 65-75% when delivered to job; ¾-in. bituminous seal; capillary action up from the base is intended to keep wood swelled and joint in compression. Louisiana has used cypress joint strips, which are commonly submerged in an ad-

jacent borrow pit to keep soaked so they won't draw moisture from the fresh concrete during curing period. New Jersey also reports good preliminary results with wood filler, still considered experimental, however.

"I've never found anything wrong with a wood joint," observed Prof. Scholer, "They are not popular probably because no strong promotional agency is behind them nationally." Weights of some woods are too low to meet AASHTO specifications, it was said. Wood joints are conceded to work best in a wet climate.

Concrete Mix Design—Need for continued variation to meet climatic

and other local variables was expressed. Prof. Scholer urged more consideration of special concrete around joints (smaller aggregates), and reminded that *mixing* and *placing* are neglected considerations; engineers make adequate designs but don't always get what they specify.

Concrete Curing—We still aren't always sure of 100% efficient curing, said one spokesman. The first 24 hours is the critical time. Lack of curing shows up later in increased cracking, as was cited on a Tennessee project. H. S. Mattimore noted the frequent early disintegration of culvert and bridge headwalls and railing,

in contrast with more durable pavement on the same project. The answer is often lack of curing. Membrane materials should make curing of vertical surfaces relatively easy today.

Aggregate Factor—In a paper on condition of Kansas concrete pavements as affected by type of coarse aggregate, L. V. White and R. C. Peyton of the Kansas highway commission found that 60 to 70% of pavement built since 1930 is still "good" or "excellent," as are many older slabs; that further research is needed to evaluate specific local stones and gravels.

Research Plans In Specific States

Thoughtful replies from material and research engineers reveal wide range of projects, including several new subjects, and trend toward more complete integration of research with planning, design, construction and maintenance

FOLLOWING are comments from several state highway research and material engineers. Addressed to the Editor of **ROADS AND STREETS** in advance of the Highway Research Board Meeting last January, the state programs and philosophies outlined make an interesting supplement to the foregoing national outline of major projects proposed under the Board's correlation service.*

California Expanding Program

From T. E. Stanton, materials and research engineer, California division of highways:

An expanded research program will parallel our postwar construction. This is a logical development for the reason that we take advantage of construction, as far as possible, to carry on important investigations in the field. Research in California has never been a side issue, at least for the last two decades, and as time goes on everybody connected with the organization becomes more and more convinced of its necessity if we are to keep ahead of the destructive agencies of man and nature.

It has always been our policy to

endeavor to correlate laboratory procedure with field experience. We are not contemplating any changes in our organization set-up, just expanding as new problems demand attention.

Following are a few of California's active or contemplated projects:

(1) Long-time joint study. In 1941, we took advantage of a p.c.c. pavement project under construction to participate in the nation-wide program to study the problem of joints.* This will be a long-time study of the movement at expansion and weakened plane joints. The project has been expanded to include studies of pavement curling, deflection under heavy loads, effect of dowels for load transfers, etc.

(2) Observation of load transfer devices. Such devices were installed in a concrete pavement in 1938 and deflections under static and dynamic loads measured. The long-time performance is under observation and additional load transfer tests are to be made under the presently heaviest permissible dual axle loads.

(3) Studies of additional subgrades, joint movement and deflection under heavy loading, as well as

the effect of air entraining agents on the durability and volume change of concrete. At least four additional projects of this type for 1946.

(4) Continued observation of the performance and economy of portland cement treated bases under relatively light bituminous surface, as well as under thicker asphaltic and p.c. concrete pavements. Additional projects planned.

(5) An intensive field study, in that connection, for development of the most suitable method of treating bituminous binders or aggregates to prevent stripping when the aggregates are of a hydrophilic nature. One of the most serious problems concerning bituminous surface construction and maintenance.

(6) Expanded studies in connection with the consolidation of embankments and the stabilization of subgrade materials with either bituminous binders or portland cement.

Traffic Line Paint

(7) Intensive studies to develop the most suitable formula for a traffic line paint, to take advantage of developments in synthetics. Good progress is being made.

(8) Studies resumed on durable and elastic crack filler. Work before the war has proved the high quality of a suitable asphaltic road-oil plus rubber-latex mixture. The studies are being expanded to include synthetic products developed as a substitute for the commercial rubber latex. Satisfactory results have been secured in the laboratory and laboratory-developed products are being demonstrated in the field.

(9) Continued cooperation with the Portland Cement Association's sponsored committee on the long-time performance of cement in concrete.

(10) Miscellaneous long-time studies, such as: performance of steel

*See also Kentucky's program, reviewed in December, 1945, **Roads and Streets**.

*For a preliminary report, see HRB 1946 proceedings.

sheet piling exposed to sea water; treatments of timber against deterioration from weathering agencies; and protective coatings for steel bridges.

(11) Numerous minor laboratory projects, particularly in connection with the development of accelerated test procedures in the laboratory, from which field performance can be accurately forecast. This is a never-ending job, but it is felt that the advances which have been made from year to year have fully justified any costs connected therewith.

Missouri Leader Urges Coordination

From F. V. Reagel, engineer of materials, Missouri highway department:

Our plans for postwar are not too well crystallized as yet due to continued shortage of experienced personnel. This situation is improving as some of our men return.

Our present inclination is to expand our research effectiveness by giving more attention to co-operative work, made possible by the new research correlation service. Anyone interested in highway research should be informed about this program and lend it active support, if possible. In our opinion, some of the most important problems which demand early solution are:

(1) Evaluation of various methods for preventing joint pumping in concrete pavements (design correction, and maintenance correction).

(2) Evaluation of soil information in terms of pavement thickness (flexible and rigid systems). Present methods continue to be arbitrary and full of large-scale assumptions.

(3) Studies of subsurface drainage as affecting soil behavior, how to control soil moisture so that the higher moisture contents can be eliminated and more nearly optimum conditions designed and maintained.

(4) Development of fundamentals involved in concrete durability, and of methods of test for control and prediction.

(5) Development of fundamental low-cost road design information that will permit the design, construction and maintenance of low-cost roads adequate for farm-to-market feeder service. (A "must" if raids by rural customers on our regular highway system programs are to be prevented or controlled.)

Definite Aims Needed

The successful conduct of a research program, further observes Mr. Reagel, requires a definite objective

or objectives, which entails competent planning, qualified full-time personnel and adequate "sales" effort to justify the expenditures required. If all of these requirements are not met, research efforts often degenerate into random experiments without proper control of variables and with production end points which cannot be evaluated.

Research work of this general character cannot be consistently sold to executives and a secondary status is inevitable. The assistance and supervision that can be furnished by a proper liaison and correlation service, provide the best answer I have to offer to improve the situation. Properly financed and capably conducted liaison and correlation service can help guide research workers so that they may properly limit their objectives and design their researches to produce definite needed information.

If all agencies try to produce the answers to all of the urgent problems,

Tree Nursery for Drift Control Plantings

Nearly forty thousand tree seedlings to be used for roadside plantings were grown last year in a co-operative project in Antrim County, Michigan. Intended among other things for use in the gradual replacement of wood snow fence, the trees represent a tie-up between the Antrim county road commission and the county soils conservation service.

The seedlings were set out and cared for by the conservation service, on a plot of ground adjoining the county highway garage.

As with many other northern

the coverage is so thin that efficient progress is nearly impossible. I am satisfied that the answer is co-operative effort, with someone at the focal point with sufficient vision and support to properly channel the efforts of the various agencies willing to work but lacking the first-rank personnel and the finances to cover the entire field.

It is hoped that the currently planned national research correlation service can be supported and designed to furnish the dynamic correlation needed, rather than the passive type which has been all that could be provided with the limited support heretofore furnished.

Ohio's Physical and Traffic Projects

Edison W. Ellis, assistant director and chief engineer, Ohio department of highways, outlines these subjects:

Physical Research

(1) Subgrade treatments built dur-

counties, the chief obstacle to the full use of "natural" snow fence is lack of right-of-way width. The ordinary 66 ft. width between fence lines seldom permits planting of trees to best advantage to protect cuts, and even a 100 ft. width is insufficient, double this width often being desirable.

Antrim County farmers are being asked to donate land for planting, with the plea that they will gain eventually by economies in snow plowing. Annual snowfall in Antrim County ranges from 100 to 192 in., averaging about 130 in. Harold Smith is county road superintendent.



★ Tree nursery for Antrim County roadside planting program

One-Day Traffic Survey in Buffalo

Said to be one of the most comprehensive traffic studies ever undertaken, an origin-destination survey was made recently in Buffalo by the New York State Department of Public Works, assisted by the State Police and the Buffalo Police Department. Covering a quarter million drivers to determine the origin and destination of traffic moving to and from the city as well as across the heart of its business section, the purpose of the survey was to determine the needs for future street improvements.

Two cordons were established, one on the outskirts of the city and the other around the business section.

Pre-addressed postcards were handed to each motorist passing in either direction through the lines established. City police distributed the cards in the business section, while State Troopers handled distribution in the outer cordon.

Each driver who received a card was requested to indicate the point at which his trip started that day. He was also requested to check his ultimate destination, the intersections passed as well as the other vital data indicating whether the trip on which he received the card was a daily journey, a frequent trip, or one seldom made. Similarly he was asked to in-

dicate whether, on reaching his destination, he parked his car at a curb, parking lot or garage, and whether the trip was for business, shopping or pleasure. Space will also be provided on the card to indicate the type of vehicle driven.

A flyer printed on 8 x 11 yellow paper was handed to motorists along with the card, explaining the purpose of the survey and requesting cooperation.

Except for the point of departure, which the driver was requested to write in, all answers were to be made by check marks. No signatures were required on the cards.

Twelve specific downtown, suburban or intermediate destination points were provided for the driver to check. Space was also provided for insertion of a destination other than those tabulated.

Ten specific well-known intersections also were listed. Drivers were requested to check those passed.

The State prepared a total of 250,000 postcards for distribution in the survey. When completely filled out by the driver after he reaches his destination the card was to be mailed to the District Office of the New York State Department of Public Works in the State Office Building, Buffalo, where answers are to be tabulated and results analysed as a guide in determining the development of state highway routes in the Buffalo Urban Area. Drivers receiving cards at both inner and outer cordons were requested to complete only the one received at the city line.

| AM | PM | NEW YORK STATE TRAFFIC SURVEY | |
|---|----|--|--|
| WHERE DID THIS TRIP START? OR If Trip Started in Buffalo Write in name of locality _____ State _____ Write in nearest intersection or well known building _____ | | | |
| WHERE DID THIS TRIP END? 1. <input type="checkbox"/> Downtown Buffalo West of Main 2. <input type="checkbox"/> Downtown Buffalo East of Main 3. <input type="checkbox"/> Westside District 4. <input type="checkbox"/> Riverside District 5. <input type="checkbox"/> North Buffalo 6. <input type="checkbox"/> Kensington District 7. <input type="checkbox"/> East Buffalo 8. <input type="checkbox"/> South Buffalo 9. <input type="checkbox"/> Kenmore & Tonawanda 10. <input type="checkbox"/> Amherst 11. <input type="checkbox"/> Cheektowaga & West Seneca 12. <input type="checkbox"/> Lackawanna & Hamburg OR-- Write in name of locality _____ State _____ (NOTE: If you received a card at the City Line, discard this one.) | | | |
| INTERSECTIONS PASSED? 1. <input type="checkbox"/> Niagara & Porter 2. <input type="checkbox"/> Delaware & Utica 3. <input type="checkbox"/> Main & Utica 4. <input type="checkbox"/> Genesee & Jefferson 5. <input type="checkbox"/> Broadway & Jefferson 6. <input type="checkbox"/> Seneca & Michigan 7. <input type="checkbox"/> S. Park & Michigan 8. <input type="checkbox"/> Bailey & Delavan 9. <input type="checkbox"/> Niagara Square 10. <input type="checkbox"/> Delaware Park | | CHECK ONE IN EACH GROUP 1. <input type="checkbox"/> Daily Trip 2. <input type="checkbox"/> Frequent Trip 3. <input type="checkbox"/> Seldom 1. <input type="checkbox"/> Parked at Curb 2. <input type="checkbox"/> Parking Lot 3. <input type="checkbox"/> Garage 1. <input type="checkbox"/> Business 2. <input type="checkbox"/> Shopping 3. <input type="checkbox"/> Recreation 1. <input type="checkbox"/> Passenger Car 2. <input type="checkbox"/> Light Truck 3. <input type="checkbox"/> Heavy Truck CHECK <input type="checkbox"/> THE ANSWERS DO NOT SIGN THANK YOU | |

★Card used in questioning Buffalo motorists

(Continued from page 83)
ing the war as to their relative merit. To include study of various types of granular and stabilized sub-bases, sub-surface drainage, etc.

(2) Studies continued and expanded on concrete pavements durability.
(3) Stripping characteristics of asphalts and benefits of additives.

(4) Curing methods for concrete as related to abrasion loss and to action of de-icing chemicals.

Traffic Research

(1) Re-inventory of the characteristics of all roads in the State beginning in 1946, including county, township and state routes.

(2) Traffic flow. The last complete data for Ohio roads were prepared in 1941. It is proposed to check 1946 conditions.

(3) For the first time, the traffic density on state road extensions into urban areas will be counted and evaluated.

(4) Origin and destination data will be secured in 1946 on main routes throughout the state, to bring into better focus the places people wish to go.

(5) In addition to these general projects, we expect to make several special traffic studies of larger urban centers; probably on the scientific sampling method used in the metropolitan area of Cincinnati.

Massachusetts to Study Hydraulic Fills

Raymond W. Coburn, acting commissioner of public works, Massachusetts, reports:

Investigation of the bearing capacity of pavement built over hydraulic fill of low bearing power is now under way and will continue for some time at our Logan Airport.

In this work we are seeking data as to (1) increase in bearing power due to various depths of superim-

posed granular fill; (2) increase in bearing power due to different types of superimposed granular fill; and (3) increase in bearing power of finished pavement due to consolidation of hydraulic fill.

In addition to the above, the Massachusetts maintenance division is making a field study on the reduction of frost action in soils by use of calcium chloride.

Dynamic Modulus of Concrete

Illinois' chief highway engineer, W. W. Polk writes:

Our research plans are not sufficiently advanced to enable me to give you definite information. It is our intention, however, to carry on research as our needs require, and possibly also some major projects. For example, our laboratory has recently acquired equipment for determination

(Continued on page 118)

Two-Bridge Rotary

Built for Controlled Access Interchange

Design details of an unusual type of interchange, built to permit immediate construction of large adjacent suburban home developments

By D. W. Loutzenheiser

Department of Design,
Public Roads Administration,
Washington, D. C.

A COMBINATION of pairs of access ramps and a rotary intersection for two cross streets was used to provide a complete interchange facility on the Shirley Memorial Highway in Arlington, Virginia. This intersection, about 1.5 miles from the Pentagon Building road network, is on the controlled access highway extending southwestward from Washington, D. C. The portion of the Shirley Memorial Highway in Arlington County, Virginia, about 2.2 miles in length, was completed in 1943 by the Public Roads Administration as an important access connection to newly developed and concentrated suburban areas. This section is the northerly portion of a 16.8-mile expressway, the remainder now under construction by the Virginia Department of Highways, being built as a part of the Interstate System of Highways between Washington, D. C., and Richmond, Virginia.

General Plan

The controlled access facility is carried through the intersection area as a depressed highway section (A-D in Fig. 1). At a level above and separated by two structures, the streets connect to an irregular elliptical rotary with diameters of about 700 ft. and 500 ft. Four-lane street connections to the rotary are provided to a rapidly expanding shopping center on the west (E) and on the east (B) to a principal street of a multiple-building apartment development. A street of similar importance but initially only two lanes wide connects at the south (C) and its extension to the north (F) is an existing two-lane street, also serving new apartment

developments. Connections between the rotary and expressway are made by two pairs of one-way ramps. Each of these ramps is designed for entrance to or exit from the expressway lanes at speeds consistent with free-way operation. Their length serves as a speed-change facility, upgrade on the "off" ramps and downgrade on the "on" ramps, to or from the slower rotary operations.

The suburban concentration in this area is entirely a wartime development, although part of it had been planned previously. The provision of the expressway made feasible the development of between 5,000 and 6,000 apartment units near a direct high-speed artery to war offices and downtown Washington. By cooperative

planning and design the right-of-way necessary for this intersection was made available by the apartment and shopping center developers. All parties concerned recognized the importance of separated interchange facilities at this site, and after study of all likely intersection types the bridged rotary form was selected. The through traffic on the cross streets was of less importance than the turning movements at the intersection and a rotary well fits this traffic pattern. Also, it was considered the best adapted to the topography, the need for minimum right-of-way usage, the aesthetic controls of both the park-like expressway and permanent apartment developments and the funds available for construc-

★ Shirley Memorial Highway shown in relation to the extensive suburban area it serves

War Department Photo



tion. Construction of the initial 2.2-mile section of the Shirley Memorial Highway was started in 1943 and was completed, including the rotary, in June, 1944. Most of the adjacent apartments were completed during 1945 but the shopping center is still under construction.

35 mph. Rotary

The expressway is designed for safe operations at a speed of 70 mph. and all cross roads are eliminated or separated. The initial four-lane section consists of two 24-ft. concrete pavements with continuous outside shoulders of 10-ft. width. A continuous median of 30-ft. width is provided to permit expansion to a 6-lane facility with a 6-ft. median. All slopes are reasonably flattened and well-rounded as a parkway section within a right-of-way 200 to 300 ft. wide. A feature of the expressway is its "spline-line" design with flat transitioned curves and corresponding high-type profile. It was essential that these characteristics be retained through all intersections.

The rotary speed is 35 mph. and it consists of a series of compound curves with radii between 220 and 715 ft. Careful study was required to shape the rotary to provide suitable "weaving" lengths between adjacent entering and exit roads and to eco-

nomically fit the topography. With through traffic on the separated expressway, the rotary movements of major importance are (1) those occurring daily, largely in peak hour flow, between the east (B) and south (C) connections and the north ramps (A) in home-to-work movements, and (2) continuous movements between the shopping center on the west (E) and the south, the east and the north connections, B, C and F, respectively. Movements to and from the southwest ramps (D) are of less importance. All roads entering or leaving the rotary are channelized into one-way movements. Right-of-way restrictions made 50-ft. radii necessary on the west connection but all others are suitable for a speed of at least 30 mph. The two ramps for entrance to the expressway are designed on a nearly tangential alignment to permit easy exit from the flat sides of the rotary. The two ramps for exit from the expressway are curved to the right as they approach the rotary, entering it at weaving areas on the sharply curved portions. These alignment controls combine to locate the rotary assymmetrically over the expressway.

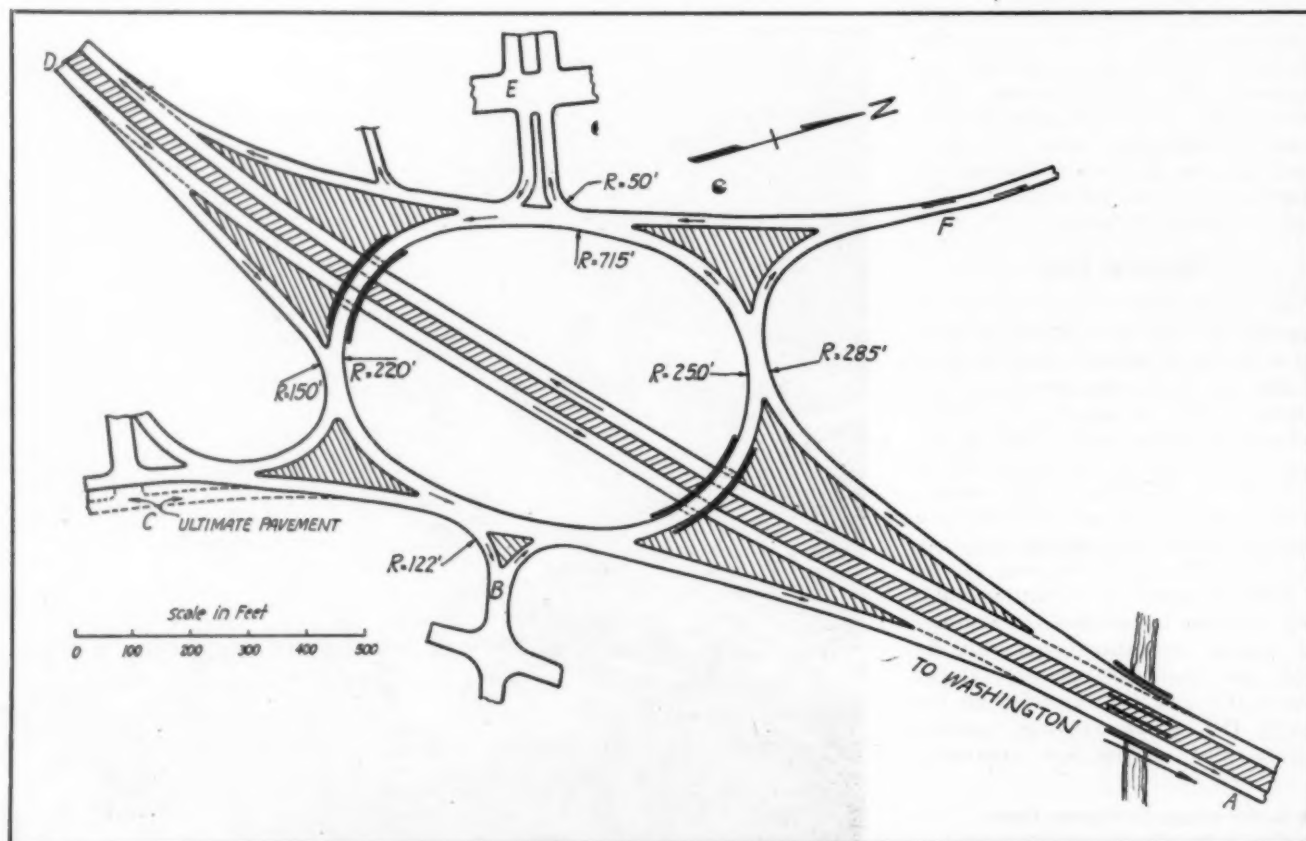
The rotary roadway is a bituminous surface on concrete base and consists of two 13-ft. lanes completely around the ellipse with a third outer lane in

all weaving areas. This line is at least 10 ft. wide on the curved north and south weaving lengths and at least 8 ft. wide along the flat sides. The inner 13-ft. lane is superelevated for 35-mph. operation and the other 13-ft. lane for about 30 mph. The third lane is superelevated to the outside in a manner to fit the connecting roadways and to not exceed a 5 to 6% cross slope difference at the crown line. Full superelevation is carried over both structures. A 6-in. slope-faced curb is used on both edges of the rotary roadway and for short distances outwardly on the ramps and connections.

The rotary roadway which is about 1900 ft. around the inside is on a smoothly rolling profile with two crests. These lie just ahead of the two structures, in the direction of travel, and the low points are in the vicinity of the east and north connections. The whole rotary slopes toward the north, the south profile crest being 23 ft. higher than the low point at the north, with about 500 ft. of a 4% upgrade between. All crests on the rotary or connecting roads are designed to provide sight distance consistent with the likely speed of operation.

Bituminous Ramps

Ramps and connecting roadways



★ Fig. 1. General plan showing principal dimensions of the two-bridge rotary and functional elements referred to in the accompanying article



War Department photo

Picture of the Month

The national housing program focuses attention anew on suburban expressway facilities, such as the Shirley Memorial Highway out of Washington, D. C. This aerial scene and the accompanying article describe an unusual "bridge rotary" solution to the problem of providing safe, smooth interchange of traffic between the depressed expressway and large new housing developments adjacent



★ The two bridges of the rotary as seen from the depressed expressway

which also are bituminous surfaces on a concrete base, are 20 to 24 ft. wide, with 2 to 4 ft. of extra width at the roadway forks. These roadways include a shoulder section at least 10 ft. wide around the rotary and 5 ft. wide elsewhere. On the four ramps a high type alignment and profile is provided at the expressway terminals, with the outer edge of the through pavement clearly delineated by the pavement contrast. Since the expressway is on a downgrade of about 2% to the northeast, the steepest profiles are on the north ramps with a 5.5% gradient on the upgrade and 8.0% on the downgrade. It was necessary to widen the Four Mile Creek bridge on the west to provide the desired terminal design for the "off" ramp. By use of extra length vertical curves with sight distance in excess of that of the rotary design speed the two "off" ramps were provided with suitable platform areas at the rotary level.

"Spline-line" Design

In the design of the intersection considerable use was made of "spline-line" and graphical solutions for profiles and pavement layout details. Alignment was calculated on a coordinate system for the expressway centerline, the inner edge of the rotary roadway and the outer right edge of the ramps and connecting roads. True profiles for the rotary, ramps and connections were determined graphically for these lines, first plotting a series of control points as determined by structural clearances, maximum gradients, cross-slope rates and lengths for its change, etc., and then developing a smooth spline line approximating such control points. Profiles for the lane lines and other pavement edges similarly were developed as smooth lines on the same plotting bases through proper consideration of superelevation requirements and rates of change in cross-slope. For final details the whole rotary roadway plan was plotted to a scale of 1"-20' and the details of curved nose location, pavement widening, etc., graphically de-

termined. Simultaneously edge and lane line profiles were prepared to the same scale (1"-1' vertically) from which the construction elevations were read directly. This procedure was considered essential in correlating properly the three-dimensional aspects of warped pavement design to produce a desired smoothness and accuracy of pavement elevations.

Earth slopes between pavements were designed by the development of contour grading plans, which means assured a natural rounding of the warped slopes without any semblance of a harsh "standard" cross section. Such grading plans, on a scale of 1"-50', and with 1- to 2-ft. contours, were used as the construction control, any point being quickly determined on the coordinate system. The interior of the bowl consists of smoothly rounded slopes varying from about 2:1 near the structures to 8:1 at the center. The northwestern two-thirds of the rotary roadway was embankment construction with a maximum height of about 21 ft. Slopes between the ramps and expressway were held to 2:1 maximum. Drainage arrangements were of the conventional types, with field inlet grates located in flat swale sections.

Rigid Frame Structures

Both structures are two-span rigid frames with plain concrete faces and stone faced wing walls. The center pier is 2 ft. wide and abutments are offset 8 ft. from the edge of pavement, resulting in normal spans of 46 ft. Design loading is H-20. The upper levels carry a 26-ft. curb to curb roadway on curved alignment with a 2'-6" safety walk width on the left and a 6-ft. walk on the right. Rotary curbs are transitioned to an 8-in. height over the structures.

Pedestrian facilities are as yet incomplete, pending further study of the extent of bus operations and the location of suitable bus turnouts. Walks will be provided around the outside of the rotary roadway with connections to accommodate pedestrian movements to and from the shopping center. All slopes have been

seeded and mulched and other landscape development work will be undertaken soon.

Traffic is controlled by directional signs located within or in advance of the curbed noses at roadway forks. All main signs are reflectorized for night visibility and legends are of 6- to 10-in. height letters.

Thus far the interchange has served largely as a suburban terminal facility. Upon completion of the southerly sections of the Shirley Memorial Highway the expressway traffic will be greatly increased, but only a nominal increase in interchange traffic is to be expected. Recent traffic counts show a week-day average of 12,000 vehicles per day on the expressway north of the intersection and 7,000 to 8,000 vehicles per day on the one-way rotary roadway. Peak flow on the north ramps is about 700 vehicles per hour.

This project was designed by the Urban Road Division, Department of Design, Public Roads Administration, and constructed by contracts under the supervision of Public Roads Division of Eastern Parks and Forest Roads. The expressway location and design was based on preliminary studies of the Virginia department of highways.

New Jersey Cooperating on Veteran Training

War veterans are given the opportunity to qualify for road construction under a cooperative plan begun by the New Jersey state highway department. Expenses for the training period at Rutgers State University will be paid by the Federal Government under the GI Bill of Rights. Applicants are to apply to the state recruitment and replacement division of civil service. Instruction toward appointment as junior engineers or engineering aids is to start April 15 and from 20 to 25 students will be accommodated in each of the first classes. Satisfactory completion of the courses will be considered the necessary educational background for temporary appointment pending Civil Service examination. The engineering aide candidates must have completed high school. They are to study for three months and do practical work in the field for one month; starting pay \$1560, with gradual advance to \$1800.

Junior engineer candidates must have finished two years of college. They will spend six months at school and two months in the field; salary begins at \$1800.

How 1946 Looks To Us

By E. K. Porter

Partner, Porter-DeWitt Construction Company, Poplar Bluff, Mo.

PRIMARILY we are engaged in grading work—some paving but not an important amount. In ordinary times we have between 500 and 600 employees and operate several units.

The year 1946 looks like a busy one to us. Just a lot of work. There are a great number of contracts being let in this section now. Our participation, for the most, is in dam and levee work. In fact the bulk of the new business in this area has been in this line.

Road construction lettings will also mount during 1946.

We find available labor better than a year ago. However, this does not apply to trained or experienced labor. About the same condition exists here. To date we have had very little experience with returned veterans but what we have had has been highly satisfactory. There is only one angle to watch here—or so we have found: the man who has been with the Seabees or engineers, and doing construction work under actual war or combat conditions has to be retrained.

His training was all along the line of "Get the job done at all costs," and in most cases this was at costs to equipment. And we are still trying to make our old equipment last.

Preventive Maintenance Pays

We have put in a strict preventative maintenance program and are using field shop units with each job. We are finding that this policy not only gives us the best results but is the cheapest.

Just as soon as deliveries can be made we will dispose of all of our present equipment and replace it with new. This does not go for our portable welding units or the field repair shops.

At present we have four draglines, 9 carry-alls, 1 elevating grader, 17 Euclids, 6 Tournapulls, and 18 tractors, besides the general line of small equipment. We use a great deal of wire cable in our operation and wartime contracting has taught us that the preformed type is much the cheaper and safer for our work.

We will continue for our present maintenance policy when our old equipment has been replaced with new. We can see no reason for going

back to the old way of replacements instead of preventative maintenance. By servicing our wire ropes we have been getting nearly double life. We will continue this. Changing ends, cutting back, and using ropes retired from small sheaves and drums for guard rail and guard duty makes sense. More especially is this possible when preformed is used since this rope handles easier and faster and broken crown wires do not wicker out to become vicious jaggers.

We have found that we can build a good deal of our equipment in our own shop. We will continue doing this, or at least until new equipment of our particular type is readily available.

Novel Design for New Traffic Light—A new traffic light designed along psychological principles has been developed by a Detroit engineer.

When the red is showing a square of light will be visible. Transition from the red to a green circle is accomplished through an amber light of oblong shape.

Latin-American Engineers on Inspection Tour

Latin-American engineers who will receive a year's training in American road building under the Inter-American Highway Training Award will begin a nation-wide inspection tour in May. The American Road Builders' Association is sponsor of the program in conjunction with the U. S. Department of State, Public Roads Administration and other departments of government.

The purpose of the trip is to show the visiting engineers typical state, county and municipal highway departments in operation, manufacturing plants making highway equipment, and actual highway construction projects. A 1400-mile itinerary from Washington, D. C., through the middle-west will include a score of selected cities.



★ Porter-DeWitt at work on Clearwater Dam, Piedmont, Missouri

★ Why drop the thrifty preventive maintenance tricks we learned during the war, queries this contractor



New developments in use of asphalt in Erosion Control

Asphalt has been used to a rather large extent in the control of erosion on river banks, notably on the Mississippi and Missouri Rivers and on the West Coast. Its use on highway embankments and slopes is more recent. Some methods of its use for this purpose are comparatively new and further research and study will be required to develop its most effective use

THE use of asphalt in control of embankment erosion may follow one of two procedures:

(1) Use of an asphaltic concrete mat for protection of road embankments against wave or current action where the road follows a lakeshore or river, or borders an area subject to flood water.

(2) Use of a thin film of asphalt for protecting the roadside soil against wind or rain water erosion and to stimulate a plant growth as the permanent protection.

Asphaltic Concrete Mat

This method consists of the use of an asphaltic concrete mat to protect the slopes of embankments on top of which the highway is carried. It includes trueing up the slope and compacting it reasonably well after which asphaltic concrete 2 in. to 6 in. in depth is placed depending on the severity of the erosion from currents, waves or ice jams. The mat is anchored at both the top and toe of the slope by filling a trench some 18 in.

Paper read at Fifth Annual Short Course on Roadside Development, at Ohio State University, February 27 and 28, 1946.

deep and 6 in. wide with asphaltic concrete integral with the surface mat. Sometimes wire mesh has been incorporated to aid in protecting the mat against disruption where the wave action or ice jams are severe.

At other times the mat is molded to a thickness of about 3 in. on a floating dredge from which it is conveyed onto the sloping bank both above and below the water line, as may be necessary. A later development, when above the water line, is to place the asphaltic concrete to a considerable thickness by any convenient means and only reasonably level the surface and without any particular effort to do a perfect job of compacting and smoothing as a pavement is laid. This larger quantity of material placed by low-cost methods supplies the strength as well as the mass necessary to resist displacement by the waves or current.

The above procedures are employed on shore lines of rivers, lakes and on embankments subject to high water, where there is wave or current action. Its wider possibilities lie in prevention of ordinary soil erosion. High fills on which roads are placed are sometimes built out of gravelly or sandy soil as it is the available

material.

Such soils erode readily and usually require some artificial protection until a growth of vegetation can be developed. I know of one road embankment that is eroded away from 2 ft. to 4 ft. in depth on an average of about every three years when the high water permits severe wave action on the gravelly soil. On such a slope an asphalt mat will last many years, and completely prevent such deterioration.*

Thin Film of Asphalt

In this method a thin film of asphalt is applied to a soil on a prepared slope after it has been seeded and saturated with water either by rain or artificial sprinkling. Two slightly different procedures have been followed in the past; the one used more particularly for protection of sand slopes against wind erosion and the other the protection of soil against water erosion.

*A discussion of the use of the asphalt mat to protect embankments against erosion will be found in The Asphalt Institute's publication, "Construction Series No. 43—Water Control and Erosion Prevention Using Asphalt." A new publication of The Asphalt Institute entitled "Manual on Water and Erosion Control" will soon be available.

★ (Left): Raking in grass seed before sprinkling and application of asphalt. (Right): Sprinkling seeded area with water previous to application of asphalt



Both methods serve the same purpose. The film of asphalt not only protects the soil against erosion from wind or rain, but also aids in retaining the moisture in the soil. It also raises the temperature of the soil slightly, which contributes to early germination of the seed. These two methods are described under (a) and (b) below:

(a) **Oiling Sand Soil to Protect Against Wind Erosion.** This has been done by the application of about 0.2 gal. per sq. yd. of slow curing asphaltic oil of an SC-1 grade to a sandy soil primarily to prevent wind erosion. Where a much larger quantity of the oil is used on a sand slope, the film may break away of its own weight. If a smaller quantity of oil is used the film is unstable.

The oil is applied to the prepared slope by the use of a hand hose and nozzle or from a spray bar if the slope is such that one can be used. The oil is heated to about 165° F. and should be applied in the early spring when there is moisture in the ground. A second application of the oil is used where the first is not effective. Under this method natural growth from seeds forces its way up through the thin film of asphaltic oil. After a slight growth is started and the film of asphalt has cracked, the slopes are re-seeded by natural processes which eliminate the necessity for further oiling. This method has been used most extensively in Oregon, on the sand dunes adjacent to the highways, and on the cut and fill slopes through the sand.

The oil should be applied early in the spring as the distillate in the asphaltic oil may be temporarily somewhat toxic to plant life if applied on the young plants. This method has generally been used with a minimum amount of detail work so that the cost could be kept low when applied to a large area on which roadside growth was desired.

The method is described by R. H. Baldock in the March 1940 issue of "The Asphalt Forum" published by the Pacific Coast Division of The Asphalt Institute, 100 Bush Street, San Francisco, California.

(b) **Use of Cutback Asphalt Film as a Protection Against Erosion and to Stimulate Plant Growth.** In this method the slope is prepared and grass seed raked or harrowed into the soil. After a rain or sprinkling of the slope with water so that the soil has abundance of moisture, a thin film of the asphalt is sprayed on the soil as in method (a).

The asphalt thus applied serves two purposes: It temporarily protects the slope against erosion from wind

and rain; and it aids in holding the moisture in the soil until the plants have developed sufficient root growth to be resistant to droughts. The plants push their way up through the thin film of asphalt or come through the cracks formed in the asphalt film.

Experience indicates that the quantity of asphalt giving best results is about 0.2 gal. per sq. yd. If less than this quantity is used it will disintegrate too soon. If much more is used it forms too thick a mat to permit the emergence and growth of grass. This thin film of asphalt not only helps to retain the moisture in the soil and protects it against erosion, but also absorbs the light rays which produces a slightly higher temperature which encourages the plant growth. The asphalt film cracks readily from shrinkage which aids the plants in coming through the surface. The asphalt film completely disintegrates in about a year's time.

Grade of Asphalt

The grade of asphalt that is said to give most promising results in this work is an MC cutback which consists of asphalt cement fluxed with kerosene. Those that have worked on this development report that a comparatively hard asphalt base of less than 50 penetration, airblown with a special treated kerosene distillate to remove its toxicity to plant life, has shown most favorable results.

It would seem also that some grade of emulsified asphalt would be suitable for this work.

Regardless of the type of asphalt, it is preferable that there be used a comparatively hard asphalt base that will remain brittle under all atmospheric conditions. The hard asphalt cracks more and permits the grass seed to come up through the surface more readily; also the cracks assist in re-seeding where necessary.



★ (Above): Missouri state highway forces applying asphalt over a freshly seeded slope. Ordinary gravity distributor tank used. (Below): Missouri roadside, grass growing through asphalt mulch several months after seeding

SUMMARY

1. Asphalt revetments to prevent erosion of river banks have been used successfully for a number of years, particularly on the Mississippi River and on the West Coast. Use on roadsides is a more recent development.
2. Two principal methods for prevention of erosion on roadsides are: (a) asphalt mat of definite thickness, to become a permanent part of the road structure, particularly where the embankment slopes are subject to scouring action of water; (b) thin asphalt films to aid in the earlier establishment of turf than can be obtained by other methods.
3. Considerable experimentation in the use of asphaltic products has led to development of materials and procedures best suited for different situations.
4. For quick establishment of good turf, both on highway roadsides and other similar areas, the use of thin films of asphalt to prevent erosion of newly made seedbeds, as well as to aid in full germination, offers great possibilities.
5. The thin asphalt film is usually cheaper than straw mulch, is non-toxic, is free from weeds and is quickly and easily applied over large areas when moisture conditions are more favorable.

Kind of Seed to Sow

Naturally the seed of a plant that is native to the area must be sown. In experiments thus far made, certain seeds show a better emergence than others. It is suggested that a mixture of various seeds indigenous to the area be sown until it is learned which may be most satisfactory. Grasses that have shown good emergence through the asphalt film on Missouri experiments are Bermuda grass, Korean lespedesa, alfalfa, yellow sweet clover and alta fescue. In greenhouse experiments timothy showed excellent results.

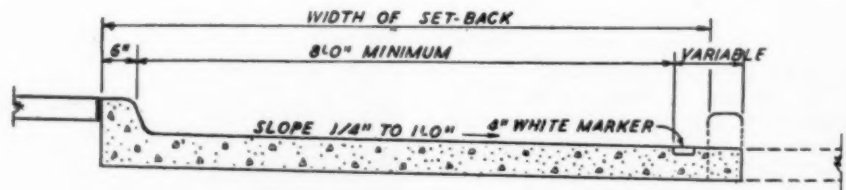
From the experiments that have been carried on in some places the process is reported upon very favorably. The method might be used effectively in developing a growth on levees which are frequently of soil that erodes readily and where it is most important to stimulate a sod or other plant growth to protect them against erosion.

A description of the work of using asphalt to encourage roadside growth done by the State Highway Department of Missouri is found in an article by Fred R. Bruto in Dec., 1945, "Better Roads". Rollin L. Smith* formerly with the Kansas State Highway Department, in co-operation with the Missouri State Highway Department, has carried on research work in the use of asphalt mulch for roadside growth.

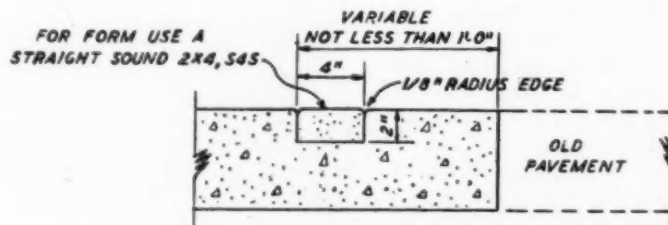
A common procedure in developing

*Patent No. 2,333,959 issued to Rollin J. Smith covers the use of any bituminous materials used as a mulch in seeding operations.

a roadside growth is the use of a mulch of straw. This is very effective. One of its disadvantages, however, is its loss by fire with the resultant damage done to any plant growth. For this reason the use of the asphalt film on the road shoulder might be particularly desirable in some places. Also the straw mulch often introduces objectionable weeds. Not only would the asphalt mulch be free from these two objections but at times straw mulch is not always readily available. Experience would indicate that the asphalt mulch system warrants a trial to learn of its relative effectiveness and cost as compared with the more conventional methods now in general use.



SECTION SHOWING LOCATION OF MARKER



DETAIL OF WHITE MARKER

White Line to Indicate Parallel Parking

From Ralph Lee, city engineer, Oklahoma City, comes the accompanying sketch, showing one detail of this city's effort to regulate parking on narrow streets. It shows how a white cement mortar stripe is inset in pavements about 8 ft. out from the curb, on streets where diagonal parking is not permissible.

The idea of a white line is not new but Oklahoma City is believed to be among the first to attempt the use of a permanent line for this purpose.

States Mr. Lee: "We are just starting the use of this method and propose to require cut backs of 8 ft. or more and require parallel parking from 8 ft. to 15 ft., then allow angle parking for 15 ft. and up cut backs."

The specification for the marker reads as follows:

"The materials shall consist of white portland cement and white sand. The mixture shall consist of one part white portland cement and two parts white sand with sufficient water to form a plastic mix. Immediately after the concrete is placed and struck off a straight sound board shall be embedded in the fresh concrete. The pavement edge shall be edged with a 1/4-in. radius edger. As soon as the concrete has hardened sufficiently to stand, the marker form shall be carefully removed. The bottom of the recess shall be roughened and the white mortar placed immediately. The white mixture shall be compacted with a wooden hand float and finished with a heavy steel trowel then edged with a 1/4-in. radius edger. It shall then be cured using the same method as the remainder of the concrete."



★ How grating looked before work began. Pavement immediately surrounding the grating was in excellent condition

Step-by-Step:

RAISING A CATCH BASIN GRATING

Photos taken by staff of Fred Swineford, Chief, Bureau of Construction, Ohio department of highways. Contractor was Union Asphalt Materials Co., on job in Fayette County, Ohio



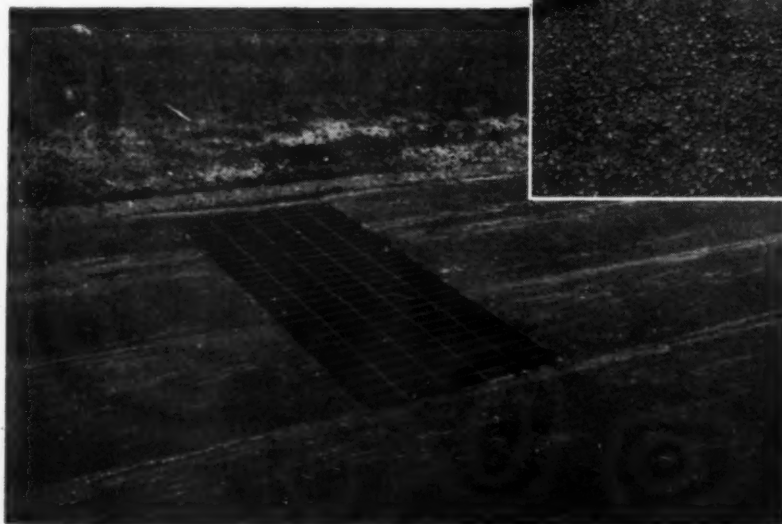
★ Grating was removed, grating frame and seat raised 2 inches and reset. Welder with portable outfit burning off rusted anchor bolts preparatory to setting new bolts in mortar



★ Here is the raised frame, with a temporary collar of hot-mix placed to protect it until the resurfacing crew comes along



★ A bit of hand raking was needed before rolling the surface course



★ The job is done—a neat piece of workmanship. Note that the grating is set a very small fraction of an inch below the finished surface



★ Completed resurface and median strip across the bridge

Bridge Deck Modernized

by adding median strip and resurfacing

Replacement of expansion plates also involved in repairs to bridge approach and deck at Toledo, Ohio. A. S. Langenderfer & Co., contractor

AN EXAMPLE of repairs which not only salvaged a worn pavement but added measurably to safety and traffic efficiency on a large-volume urban bridge, is a recent modernization of approaches and deck of the Anthony Wayne high-level bridge at Toledo, Ohio.

The bridge in question is a 785-ft. suspension span with 233-ft. anchor spans. The original pavement had a width of 54 ft. 6 in., providing for two lines of traffic in either direction. A new pavement surface became necessary because of scaling and pitting from the repeated use of ice removal agents, spread in an effort to minimize skidding on the ascending approach grades.

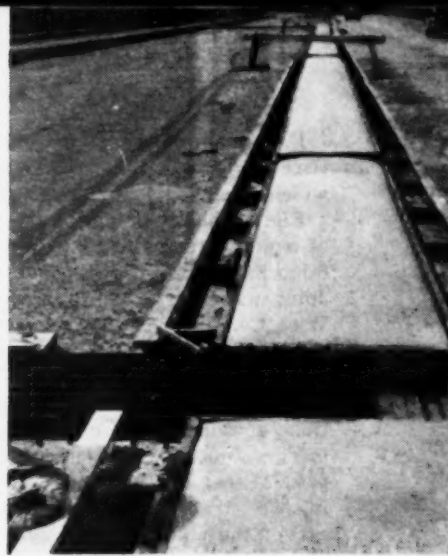
The repairs included three major steps:

1. Construction of a median strip 4 in. thick at edges and 7 in. thick at center to create a four-lane divided highway.

2. Placing of a 2¼-in. asphaltic concrete wearing surface over the concrete on the bridge and approaches.

★ **BEFORE**—Looking along one of the approaches, showing old pavement prior to improvements





★ Showing how median slab was anchored to concrete with dowels and finished by hand; and also details of forms and expansion joint reconstruction prior to resurfacing

3. Reconstruction of expansion joints made necessary by the raise in the surface grade.

Median Strip Construction Under Traffic

Traffic was maintained during construction of the project. This caused the bridge to vibrate and made it difficult to finish the concrete median and hold the 3-in. crown. It was necessary to hold the water content of the concrete to a minimum, and at the center portion of the bridge vibration was so great that traffic was detoured for several days.

As shown in the accompanying photographs it was a relatively simple job to drill holes at staggered intervals along two lines in the concrete pavement and insert dowels to anchor the median slab. The slab was formed by braced wooden forms held in position by means of sacks and sand, as shown in one of the photos.

Resurfaced in Stages

The resurfacing was laid in several stages after joint work and median strip were completed. Concrete pavement surface was first cleaned and a prime coat of asphalt emulsion was applied at rate of .10 gal. per sq.



yd. Next a one-inch leveling course of asphaltic concrete was placed with paver in four lanes, followed by 1½-in. top course. Slag aggregate was used in the asphaltic mix and the additional weight on the bridge, including concrete median strip, amounted to approximately ¾ ton per lineal foot. Elevations taken before and after resurfacing indicated that the center of the main span was

★ Fig. 1. Main expansion joint partially removed

6 in. lower under the additional load. This settlement of the deck of the bridge under the additional load flattened the vertical curve of the main 785-ft. suspension span and was no more than was anticipated.

Expansion Joint Replacement

Steps in the replacement or relocation of expansion joints are shown in Figs. 1, 2, 3 and 4. These changes were made necessary by the raising of the grade in resurfacing.

Fig. 1 shows the partial removal of one of the two main expansion joints located at the ends of the suspension span. This 3½-in. thick steel joint, consisting of double steel bars or fingers, is being replaced with a new built-up section 6 in. thick. 2½-in. x 2½-in. angles were welded to the supports of the joint shown in the background to provide headers to hold new bituminous surfacing.

★ AFTER—Same scene as shown on opposite page, after dividing and repaving



Fig. 2 shows complete removal of the old joint and original supports, which are used for the new joint.

Fig. 3 shows completed installation of a new joint built up with 1½-in. x 6-in. bars with 2¼-in. open spaces. Joint was fabricated by Art Iron & Wire Co., Toledo, Ohio.

Fig. 4 shows the expansion joints at the ends of the 233-ft. anchor spans being raised by welding sections of 3-in. commercial welded steel bridge floor grating on top of the present expansion joint. The grating was filled with asphaltic concrete, except the panel directly over expansion space where the grating was cut to allow for movement.

The expansion joint work was done under the direction of T. W. Reeves, commissioner of harbors and bridges for Toledo, with his maintenance forces. The paving and construction of concrete median strip were done by A. S. Langenderfer & Co., of Toledo, under State of Ohio, department of highways, contract let late in 1944.

Work was completed June 29, 1945. Fred Kuebler was state project engineer. Photographs were taken by L. J. Brannon, engineer, state highway department, bureau of construction, Fred Swineford, chief engineer.

Status of Federal Aid Projects

The status of Federal-aid projects on March 9 was reported as follows: 1,166 projects, estimated to cost \$139,706,000, approved by the Public Roads Administration for letting of contracts; 397 contracts for highways and bridges, valued at \$47,275,000, awarded by state highway departments but work not yet begun; 1,546 projects comprising improvements on 2,307 miles of roadway, including 650 bridges, at a total cost of \$190,298,000, under construction.

Status of Road Plans

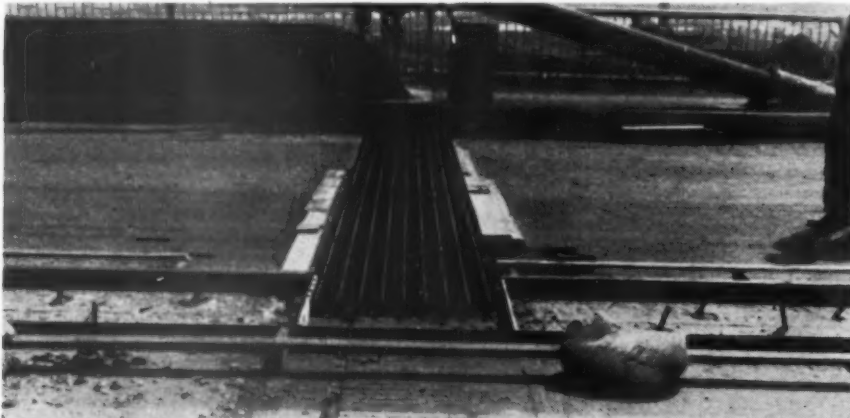
Plans for highway improvements estimated to cost \$854,467,000 had been completed on March 1, and blueprints were being prepared for an additional \$2,663,000,000 worth of road work to be done in the next four or five years, according to reports received by the Public Roads Administration from the 48 States, the District of Columbia, Hawaii and Puerto Rico. The reports cover the combined State and State-Federal highway programs.

The completed plans included rural highway projects that will cost approximately \$654,630,000 and urban projects estimated to cost \$199,837,000.

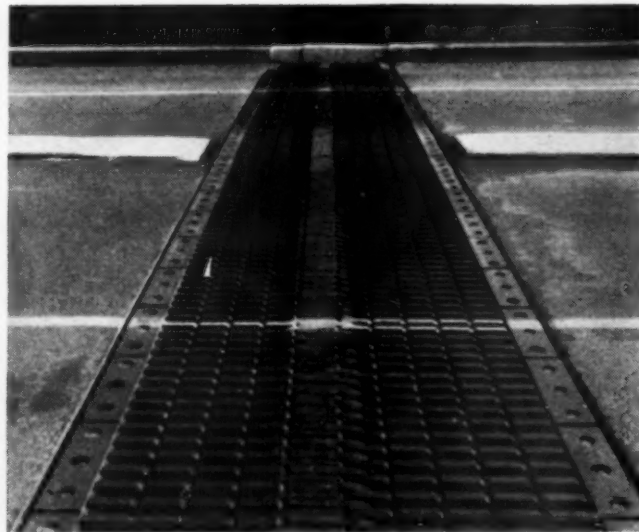
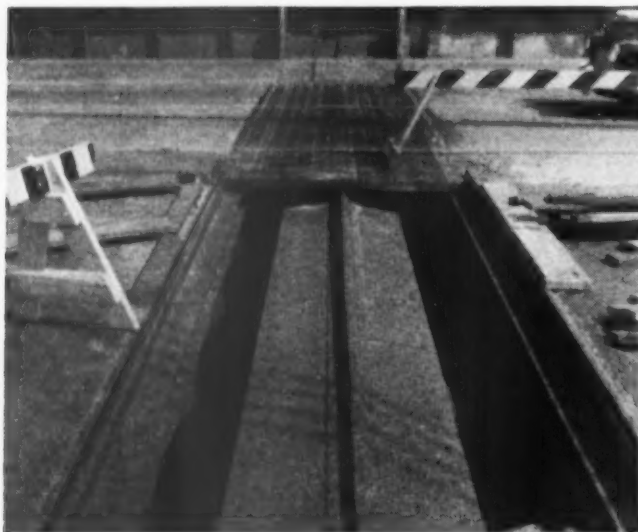
Plans now in the survey stage or on the drawing boards call for expenditures of \$1,699,164,000 on rural roads and \$963,920,000 on streets and highways in urban areas.

During January and February the State highway departments and the District of Columbia awarded contracts for 503 highway projects that will cost \$54,600,000. Of this number, 299 were Federal-aid projects involving improvements on 1,567 miles of roadway, at a cost of \$47,653,500.

The status of Federal-aid projects on March 9 was reported as follows: 1,166 projects, estimated to cost \$139,706,000, approved by the Public Roads Administration for letting of contracts; 397 contracts for highways and bridges, valued at \$47,275,000, awarded by State highway departments but work not yet begun; 1,546 projects comprising improvements on 2,307 miles of roadway, including 650 bridges, at a total cost of \$190,298,000, under construction.



★ Fig. 4. Expansion joint at end of anchor span



★ (Left): Fig. 2. Old joint and supports completely removed on near side. (Right): Fig. 3. New joint completely installed

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Recent Developments in SIGNS



Recent Advances:

New rounded letters, instead of black letters.

Increased use of reflectorizing materials.

Larger sign sizes.

Needed Today:

Greater consistency in use of latest standard signs.

Survey of sign status by states and local agencies.

Replacement or repair of weathered or wornout signs.

Better directionals specially needed; fewer signs rather than more in some areas.

★ Oversize sign; 18-in. letter and numerals

words made up of block letters of the same size. The difference was not great percentagewise, but it was there. While preliminary tests on individual letters indicated there was no great difference in legibility between block letters and rounded letters when viewed individually, it was found that rounded letters can greatly change the pattern created by two adjacent letters in a word.

In the Ohio studies the effect of spacing was investigated also. The spacing study indicated that wider spacing will apparently increase legibility, particularly when block letters are used. Wider spacing does not result in as great an improvement in legibility when rounded letters are used because rounded letters do not tend to run together as much as block letters when closely spaced. The tendency of block letters to run together when closely spaced is due to the frequency of adjacent parallel strokes.

By Harry E. Neal

Chief Engineer,
Division of Traffic and Safety,
Ohio Department of Highways

RECOGNIZING the fact that changing conditions had made it advisable to review the existing 1939 revised sign Manual, the American Association of State Highway Officials, the Institute of Traffic Engineers, and the National Conference on Street and Highway Safety, by concurrent action in 1942, provided for the appointment of a new Joint Committee to review the U. S. Manual and bring it up to date. The committee was appointed in May, 1942, and a condensed War Emergency edition of the Manual was issued in November, 1942, covering normal conditions and special data for blackout conditions.

The Joint Committee, through four subcommittees on signs, markings, signals, and islands, has been at work since 1943 on the preparation of a postwar manual. The subcommittees

From a paper presented at the Purdue Road School, Jan. 22, 1946; photos by the author are supplemented by several additional photos from other sources as indicated.

completed their work and their reports were reviewed by the full Joint Committee in Washington in December, 1945. At this meeting, some differences of opinion were disclosed and referred for further investigation and determination before the postwar edition of the Manual is printed, which will be this year.

While no radical changes in the general design of the standard signs were made there are some important changes approved by the Joint Committee which should be noted.

New Rounded Letters

Perhaps the most important change is the use of rounded letters instead of the former standard block letters. At the instance of the Joint Committee, a comprehensive study of the relative legibilities of block letters and rounded letters was made by the Division of Traffic and Safety of the Ohio department of highways in cooperation with the Public Roads Administration. These tests covered both day and night conditions and included reflectorized and unreflectorized signs.

The Ohio studies established the fact that signs with words made up of rounded letters have generally a greater legibility than the same

Reflectorizing Studied

In this study, the problem of reflectorizing was also investigated. Tests were made (1) to compare letters on a white reflectorized background; and white reflectorized coating letters on a black background; and (2) to test a theory that rounded letters are better adapted to reflectorizing with reflector buttons due to greater freedom of arrangement.

The principal discovery in these tests was quite unexpected. Four-inch white reflectorized-coating rounded letters on a black background were 20.1% more legible by night than were 4 in. black rounded letters on a white reflectorized background.



★ A comparison of the 24-in. and 30-in. stop sign. Original design of railroad sign for two or more tracks. Railroad sign with diagonal bars (present standard)



With 8-in. letters the reflecting letters on a black background were 12.7% better.

Another interesting result of this study was that reflecting button letters in rounded style were found to be 5.3% more effective by day and 10.7% more effective by night than were block letters. The advantage of the rounded letters in daylight was about that found for unreflectorized letters in previous tests, but at night the advantage was greater than any found elsewhere, indicating that rounded letters are better suited than block letters to reflector buttons.

Diamond-Shaped Sign

Another change adopted by the Joint Committee was the elimination of the theoretical distinction between the meaning of the diamond-shape or so-called slow-type sign, and the square or caution-type sign.

It has been shown that the meaning of this distinction is not understood by the driving public and probably never will be understood. Therefore, as the distinction has proven to be meaningless, the square shape is for all signs in the warning sign classification except the Stop and the railroad sign. The shapes of these two

signs—round and octagonal—have been so well standardized through usage and are so well adapted to these signs that it was not thought advisable to change them even though the majority of drivers may not distinguish them by their shapes.

The Joint Committee increased the size of the standard Stop sign from 24 in. to 30 in. This is one of the most important signs but the 24-in. size had 17% less area than a 24-in. square or diamond-shaped sign.

White on Black Most Legible

The Joint Committee also approved the use of either black letters on a white background, or white letters on a black background, for all signs of an informational nature such as directional and distance signs. The Ohio studies showed that signs with white letters on a black background have considerably greater legibility than signs in the reverse combination. The tests which established this were for legibility only, however, and there remains the question as to the relative "target" value of the two color combinations. Signs with black background and white letters do not have quite the attention-compelling value of signs with light background and are generally more difficult to locate, especially if they are in shadow. Once spotted, however, they are quite legible.

The size of the auxiliary Junction sign was increased and the word abbreviated to JCT to permit the use of 6-in. letters which can be reflectorized by buttons. The word "Junction" was abbreviated so that the length of the sign in 6-in. letters would not be too great for practical purposes.

Advance Turn Markers

A controversial question confronting the Joint Committee was with respect to the proper method of indicating changes in direction of marked routes by advance turn markers. The previous Manuals specified

the use of an "R" or an "L" in advance of a turn to indicate that the route turned right or left. Some members of the Committee argued that turns should be indicated by a straight arrow erected in advance of the turn. This, however, was objected to by other members who contended that the straight arrow should be used only at the point of actual change in direction and not in advance because a straight arrow might, if its location were not carefully

Reflectorizing Advances

In the past several years, there have been numerous advances in materials for reflectorizing signs. Sign sizes have been the subject of much discussion. Average speeds on our rural highways have been gradually moving upward, indicating the need for greater sign legibility through the use of larger signs with correspondingly larger letters and symbols and with more attention being given to the influence of letter width, height and spacing on legibility, the location of the sign with respect to the point at which the driver's maneuver is to be completed, and the placement of such signs as directional signs so that they may be readily read, are important.

chosen, turn traffic into secondary streets or alleys. To avoid such a situation it was suggested that a modification of the Turn sign arrow be used instead to indicate that traffic should proceed directly ahead to the point of turn which would be marked by a straight arrow. This question is one which is to be settled after further study by the Joint Committee.

Uniform, Consistent Use

Uniformity in design and consistency in application of signs and mark-



★ Advance indication of a right turn by an "R". "L" is used to indicate a left turn

ings is essential and the importance of this fact cannot be too strongly stressed.

Closer state supervision over the design and use of traffic control devices is essential if any practical degree of uniformity is to be attained. To effect state control there must be enabling legislation, which many if not most of the states now have, requiring that all traffic control devices erected by any political subdivision must conform to the state manual and specifications.

Legislation alone is not enough, however. There must be strong state and local administrative organizations composed of personnel trained and experienced in the field of traffic control and with sufficient authority to command respect. Definite responsibility must be fixed in one person or group in either local or state government. It is not a part-time job for someone whose major interest lies in other phases of street and highway work and who, therefore, subordinates traffic control work, or who is uninformed or indifferent regarding the importance of adequate traffic control. The administrative personnel should be fully conversant with standard practices in the field of traffic control and interested in the most efficient use of standard traffic control devices.

Stock Taking Needed

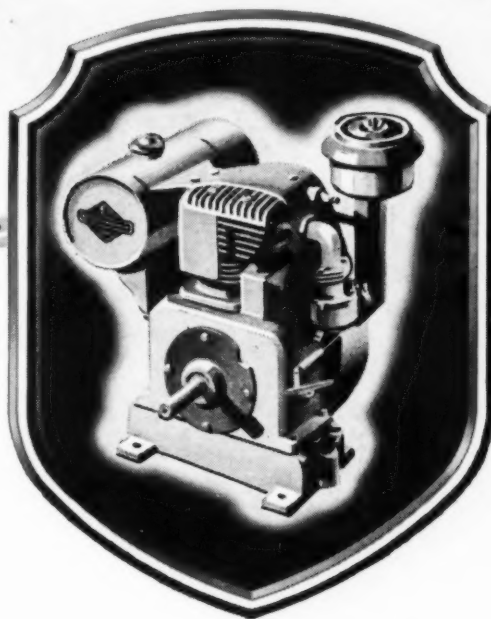
With the return to peacetime conditions, we are entering upon an era in which there will be greater need than ever before for the judicious use of measures for the control, regulation and safety of traffic. We need therefore, to take stock of our present equipment and make plans for modernizing it.

While proper signs and markings are essential to the control and regulation of traffic, their misapplication or excessive use not only wastes public funds but tends to create disrespect for them. Such misuse frequently results from haphazard experimentation on the part of those without training or experience, or on the application of such devices without a proper basis of factual study. The use of traffic control devices should not be based on guesswork or inexperience.

Because the application of traffic signs in many jurisdictions has been loosely controlled, there has been too often a tendency to over-sign. So many unnecessary signs, especially those of a warning nature, have been placed that the average motorist is likely to lose respect for all warning signs. One of the first steps in the rehabilitation of a highway sign system should be a survey to determine what signs are unnecessary, with their subsequent removal.

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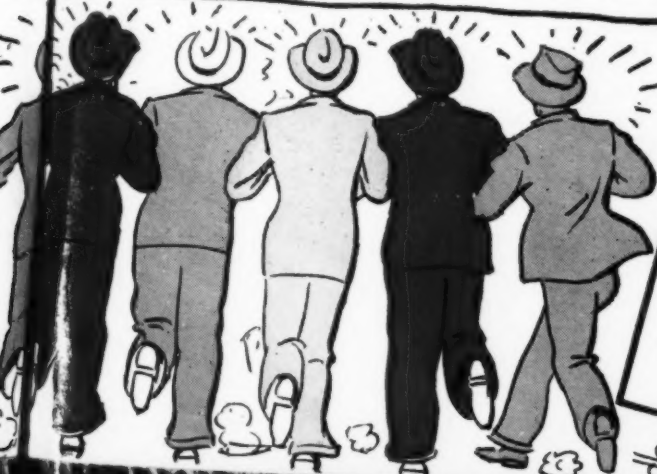
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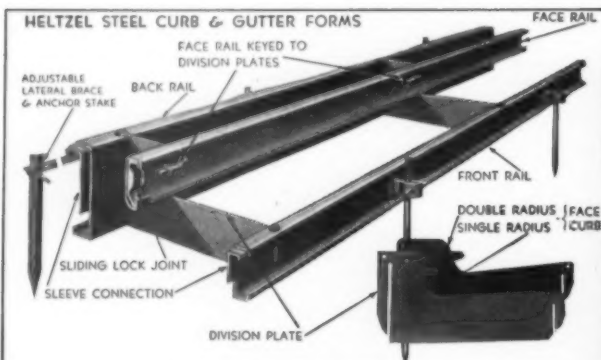
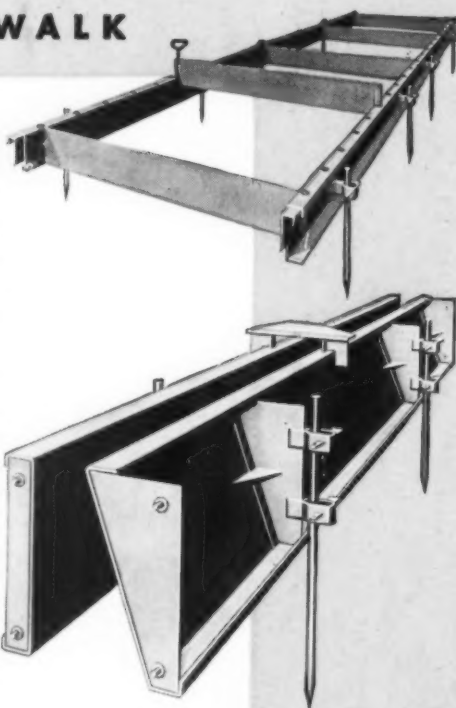
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Signs Need Renewing

Because of shortages of materials and labor, it proved impossible to properly maintain street and highway signs under wartime conditions. As a consequence, the vast majority of signs and markings are in very poor condition. This condition should not be permitted to continue any longer than is absolutely necessary. The obedience of a motorist to a sign is in



★ One of several oversize directional signs installed two years ago on the Detroit Industrial Expressway and Willow Run Expressway. (Photo by "Roads and Streets" staff)



★ Proposed turn arrow for use in advance of a change in direction of a route

almost direct proportion to the condition of the sign. A battered, rusty, or illegible sign is likely to be assumed to be one which the authority responsible for its erection does not consider very important. On the other hand, if the sign is maintained in good condition, the motorist is more likely to be impressed with the belief that there is real need for the sign and his observance of it is, therefore, correspondingly increased.

If a sign is not of sufficient importance to be read by a motorist at night as well as by day it has little place on the highway. For this reason at least all warning signs and stop signs should be reflectorized or otherwise illuminated. The exceptions are, of



★ (Left): Reflectorized directional sign, day and night. (Right): Photo courtesy Minnesota Mining and Mfg. Co.)

course, signs installed in well lighted areas where visibility is ample and those signs having daylight application only.

Route markers and destination signs, located at critical points where routes change direction, and where the motorist may be confused and make the wrong turn because of lack of adequate visibility at night, should be reflectorized. It is difficult to reflectorize most route markers and destination signs with buttons because of the lack of sufficient stroke width in the numerals and letters but glass beaded coatings make it possible to reflectorize such markers and signs very satisfactorily.

While illumination of parking signs is ordinarily not necessary, it is desirable to reflectorize or otherwise illuminate One-Way and other signs which should be readable at night.

Bigger and Bigger

It is important that consideration be given to signs of adequate size. Increasing use is being made of oversized signs with large "copy" and legends to emphasize the warning of hazards on older roads and to meet the demands for greater legibility on modern high-speed highways. Oversized directional signs have particular application at complicated rural intersections to prevent confusion by providing instantaneous readability.

There are many locations where signs considerably larger than the standard, even approaching "billboard" proportions, with correspondingly enlarged letters can be used to advantage and in fact are needed. Modern highway speeds make it necessary that the driver be warned of hazards or advised of changes in direction a sufficient distance in advance to allow him sufficient time to prepare to meet the situation and complete the maneuver in safety.

It is calculated that the driver should have at least 10 seconds in which to react to the warning or information on a sign and to prepare to execute the necessary maneuver without hesitation. At a speed of 50 mph., 10 sec. means 733 ft.

Practical sign makers estimate that each inch of letter height has a legibility distance of 50 ft. Studies have shown this rule to be satisfactory for daylight conditions and for standard width letters. For narrow letters, however, the legibility distance in the same studies was shown to be only 33 ft. In each case, the legibility distance for night conditions was reduced 15%.

The night condition is the critical one from the standpoint of legibility, and, therefore, the lower legibility value should be used. Based on a distance of 750 ft which is required for a 10-sec. warning at 50 mph., a sign placed at the point of hazard would require a Series D (normal

width) letter 18 in. high. For a warning sign placed 400 ft. in advance of the hazard, a 10-in. Series D or 12-in. Series B (narrow) letter is indicated. As the standard practice is to locate warning signs in advance of the point of hazard, the larger signs at the point of hazard should be used when it is advisable to supplement signs located in advance.

Better Directionals

Directional signs are as a general rule located at the point to which they apply. However, the practice of locating them in advance is growing in favor. Such signs with copy too small to read at a glance are frequent causes of confusion. This is particularly true where there is a multiplicity of directions. Therefore, the number of place names should be kept as low as possible and the size of the lettering as large as possible.

(Continued on page 116)



★ (Left): Incorrect location of right arrows on left of sign. (Right): Correct location of arrows. Left arrows on left side. Right arrows on right side

Weather Cycles

and Their Causes

By Halbert P. Gillette

IN THE December 1942 issue of this magazine I announced that when the planets are in heliocentric longitude 288 degrees they tend to produce an abnormal number of sunspots; from which it was inferred that they then cross a stream of galactic electrons flowing sunward. Subsequent study has shown that stream to have its center in longitude 284 degrees, which the earth crosses July 7; and that the stream of electrons flows out of the sun. It is significant that the sun's south pole is 120 degrees from 284 in longitude 164 degrees, and that there is another stream of solar electrons in that longitude the center of which the earth crosses March 6, at which time both sunspots and auroras tend to be more numerous. There is another strong stream of solar electrons 120 degrees from 164 whose center is longitude 44 degrees, which the earth crosses November 8. On November 10 to 14 not only do sunspots tend to be more numerous but so do shooting stars, this being the annual meteor shower called the Leonids. It was this correlation that first led me to infer that this fixed stream of electrons flows from the sun, carrying with it meteoric matter. When Byrd first spent a winter in Antarctica, he saw about 10 times as many meteors as he had ever seen in the same length of time. Since his camp was not far from the south magnetic pole, I infer that spiralling solar electrons attracted by that pole bring meteoric matter. It is significant that Schwabe, the discoverer of the "11-year" sunspot cycle, noticed that meteors tend to be abnormally numerous near sunspot peaks.

The longest annual shower of meteors begins about when the earth is in longitude 284 degrees, July 7, and attains its climax about a month later. Seasonal showers of meteors have been attributed to the earth's crossing hypothetical orbits in which meteoric matter travels, but it seems more probable that fixed streams of solar electrons bring such matter into our atmosphere. Evidence of this will be presented in a forthcoming book on Cycles.

Monthly sunspot numbers do not give very satisfactory evidence of the effects of planets on the sun; whereas daily sunspot numbers show that when Mercury, Venus, Earth and Mars are in heliocentric longitudes 284, 44 and 164 degrees there are, on the average, abnormal numbers of spots, the greatest number being when the planets are in longitude 284. Rainfall tends to increase when a planet is in those longitudes and this applies to all the planets with the possible exception of Pluto which is the farthest from the sun.

Intermediate between those longitudes that are 120 degrees apart, longitudes 40 degrees apart evidently mark centers of weaker streams of solar electrons, for when a planet is in those longitudes, rainfall tends to increase but to a less degree. There is similar evidence of lesser streams of electrons 40/3 or 13.33 degrees apart, and 40/9 or 4.44 degrees apart. The result is that each planet tends to cause a series of rain cycles, each cycle having a length 3 times that of the next shorter one. I had found and published evidence of such triple-progression series of cycles several years before the cause became evident.

After finding that the crossing of streams of solar electrons by planets probably causes cycles, there still remained many cycles not thus explainable. Are they caused by undiscovered planets? Or may cometary bodies cause them? The latter possibility would be out of the question were the basic cause of sunspots gravitative. But since it is probably electronic, a comet might be even more effective than a planet; for a nuclear swarm of small masses of meteoric iron would be cold; being cold it would have 70,000 times the magnetic susceptibility of molten iron in the earth's core. Hence a great stream of solar electrons near a comet would induce a powerful magnetic field in a comet nucleus containing a relatively small mass of iron. That would so attract solar electrons as to cause concentration of the electrons in a stream clear back to the sun itself, where electron whirls would tend to develop in accordance with Faraday's principle of magnetic rotation of electric currents.

As Hale discovered, sunspots are not only magnetic but whirling.

Maris and Hulburt in 1929 showed that many magnetic storms had been associated with disturbances in the heads and tails of comets. I have found that in several instances the comet thus disturbed was crossing one of the solar electron streams above inferred.

The planet Uranus is assigned an orbital period of 84.01529 years in the American Ephemeris; yet it was discovered so recently (1781) that it seems unlikely that its period is known with any such accuracy as that string of decimals indicates. Should its period be exactly 84 years it might so harmonize with that of the earth that both would be in heliocentric longitude 284 degrees at the same time. On July 7, 1908, when the earth was in that longitude, Uranus was there also.

Saturn's period is given as 29.45772 years, but since $324/11$ is 29.45455, it seemed to me likely that Saturn makes 11 revolutions while the earth makes 324. This was partly confirmed upon finding it lacked only 5 days of being in longitude 284 degrees on July 7, 1636.

In like manner, the lengths of the orbital periods of other planets were assumed to be exactly harmonic with the earth's period. Table 1 gives the assumed lengths of each harmonic period, followed by the observed length as given in the Ephemeris. Table 2 gives a date when a given planet and the earth were very nearly in heliocentric conjunction in longitude 284 degrees. Slight departures from exact conjunction are attributable to perturbations, some of which are caused gravitatively; others, I believe, magnetically. Streams of solar electrons that are affected magnetically by a planet must cause slight orbital perturbations, which hitherto have received no recognition.

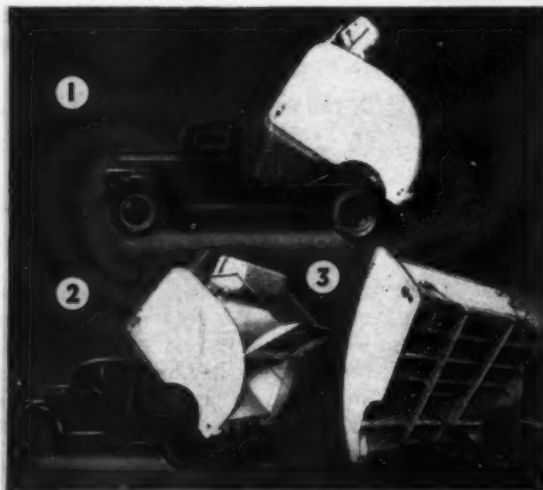
The peak dates in the last column of Table 2 were calculated in advance, as above shown, then search was made for sunspot, rainfall, tree ring and varve cycles having those peak dates. The finding of these cycles constituted confirmation of the theory.

Varves are layers of sediment deposited annually in lakes or seas. The longest, unbroken series of varve measurements in a core from an existing lake bed, Salt Saki, Crimea, is that published by Schostakowitsch in 1935. It goes back nearly to 2300 B. C., or 1000 years earlier than the oldest tree ring. Cycles found in those varves were found also in Ice Age varves. These were measured by Ernst Antevs in the Connecticut River valley, forming an unbroken

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series of 3350 years. By finding cycles in those Ice Age varves, their dates were determined; e.g., varve number 4400 was deposited 15,001 B. C. By dating those Ice Age varves no doubt is left as to the correctness of the assumption in Table 1 that all orbital periods of planets are commensurable with that of the earth, and harmonic therewith.

The lengths of most of the cycles in Table 2 have been found approximately by other researchers, but usually with errors of 2 or more per cent. At least 17 men have reported weather cycles of 32 to 37.5 years, beginning with Sir Francis Bacon, who, in 1626, called it 35 years. Bruckner (1890) assigned an average length of 34.8 years to it, although previously he and Fruh had called it 32 years. Table 2 shows that there is a cycle of exactly $31\frac{1}{2}$ years due to the combined effects of Jupiter and Earth, and one of exactly 36 years due to Saturn and Earth. One of the commonest mistakes has been failure to recognize the existence of two or more distinct cycles differing but a few per cent in length. Fortunately there is only one series of cycles, Series C, having lengths exceeding 324 years.

According to an ancient Scotch proverb, "Leap year was ne'er a good sheep year," because of its tendency to be cold and wet. The 4-year cycle turns out to be a subcycle

of the 36-year cycle, both having peaks when Saturn and Earth are crossing a stream, but not necessarily the same stream of solar electrons. Orbital eccentricity is not sufficient to prevent cooperation of the earth with other planets in causing the subcycles in Table 2.

In a previous article it was shown that electrons emitted around the axes of cyclonic sunspots have the same direction of whirl as that of the sunspot, and consequently have the magnetic polarity of the sun's hemisphere whence they escape. Hence they are magnetically attracted by magnetic foci in the opposite hemisphere of the earth. This explains several anomalies, notably that mere numbers of sunspots, without distinction as to hemisphere, are not a criterion as to the amplitudes of a weather cycle caused by them.

Weather disturbances in a given hemisphere are caused by influxes of solar electrons in five ways: (1) By generation of atmospheric currents in accordance with Faraday's principle of magnetic rotation of electric currents; (2) By the tendency of electrons to cause condensation of atmospheric moisture, in accordance with Wilson's principle; (3) by increased windiness, which increases oceanic evaporation and rainfall; (4) by increased evaporation due to increased electronic charge of water, and (5) by reduced influx of solar heat, due

to reflection of radiant waves by atmospheric electrons, and to absorption and scattering by atmospheric moisture.

During the last Ice Age, about 20,000 years ago, land-locked lakes increased greatly in area. As shown by raised beaches, Mono Lake and Owens Lake, California, had three times their present areas before overflow began. That indicates annual rainfall about threefold what it has averaged in recent years. I infer that the last overflow, and consequent freshening, of those lakes occurred near the last rainfall peak of the 16,281-year cycle about 2300 B. C., for Gale (1914) found that at the then existing rate of delivery of chlorine in salts by Owens River, Owens Lake had accumulated its chlorine in about 4,000 years. Similar calculations by J. Claude Jones (1925) give about the same length of time since Pyramid Lake, Nevada, was fresh; and by Walton Van Winkle (1914), since Albert and Summer Lakes, Oregon, were fresh. About the same time (2300 B. C.) flood levels of the Nile, scribed in the rock walls above the Second Cataract, were about 23 ft. above the highest floods of modern times; and a long period of great prosperity occurred in the Mediterranean region, as indicated by building pyramids in Egypt and monumental palaces in Crete. Then, also, began the Bronze Age which lasted some 1,800 years till near the peak of the 1,809-year climatic cycle about 500 B. C., when the Iron Age began in Europe.

The longer a cycle in a given series in Table 2, the greater its amplitude or departure from a mean. In the order of their amplitudes are the cycles of series C, H, G, F and B. The 67-year cycle of series C will have its next cold-wet peak in 1950. Its effect has been seen in recent years, notably in the very wet year of 1945 when the $31\frac{1}{2}$ -year cycle had a peak that was assisted by the 9 $\frac{1}{2}$ -year and shorter cycle peaks in that year, and by the 18 $\frac{1}{2}$ -year cycle peak in 1944. The effect of a peak of a long cycle extends over several years. For example, there were many dry years before and after 1783 which was the last dry peak of the 201-year cycle. Although its next dry peak will not occur till 1984, a downward trend in rainfall and upward trend in temperature has been evident in many regions; relieved, of course, by the opposite effects of short cycles. A noteworthy reversal of that trend will reach its maximum between 1950 and 1960, the latter date being a peak of the 324-year cycle.

In Days of Old

Roads and Roadbuilding in Years Gone by



Photo from the Bettmann Archive

★ Workmen laying the concrete pavement in New York City, 1869

It should be remembered that "permanent anticyclones are strongest about the times that "permanent" cyclones are strongest, namely during abnormal influxes of solar electrons. Hence a region that is "blanketed" by a "permanent" anticyclone may become abnormally dry when other regions become abnormally wet.

It has been objected to the theory of streams of solar electrons that mutual electrical repulsion would cause scattering of the electrons; but objectors overlooked the fact that electrons having a component of motion in the same direction attract one another magnetically. That attraction increases with the velocity. There is evidence that the velocity of emitted solar electrons is that of light. In consequence of the coherence of solar electron streams, there is little decrease in their effects even at distances from the sun vastly greater than that of the earth. Neptune is 30 times as far from the sun as is Earth, yet it causes weather cycles of outstanding amplitude. Its subcycle of 2.04 years, or, more exactly, 24.44 months, is often seen in alternately wet and dry years. At least a score of researchers have reported a weather cycle of about that length. There has been much speculation as to its cause.

In Table 2 the cycles of Series C have no known planet as a cause. The cycle of $22\frac{1}{2}$ years is double the length of the most outstanding sunspot cycle, the one discovered by a German apothecary, Schwabe, about a century ago. Only alternate peaks of Schwabe's spot cycle are ordinarily accompanied by much rainfall in the northern hemisphere. The reason for this is that sunspot numbers are usually greater in the southern hemisphere, and notably so near peaks of the longer cycles of Series C. In the footnote of Table 2 some of the longest cycles of Series C are given, along with their peak dates.

Newton's second research rule is: "In as far as possible, the same causes are to be assigned for the same kind of natural effects." This leads to the inference that the cycles of Series C are caused by orbital members of the solar system. Because of the great amplitude of the 111/6-year sunspot cycle and that of the $22\frac{1}{2}$ -year weather cycle, I am inclined to believe that there is a $22\frac{1}{2}$ -year comet having a great swarm of small iron masses as its nucleus, and that its orbit is nearly circular. There are comets of 8 and 16.3-year periods having orbits of less eccentricity than that of Mercury. Such a comet of $22\frac{1}{2}$ -year period may possibly be visible near the ecliptic near

longitude 284 degrees about July 7, 1950, when the impacts of solar electrons loaded with gases would enlarge its luminous head and possibly produce a tail. Other great comets in nearly circular orbits, at greater distances from the sun, probably cause longer cycles of Series C.

The experimental discovery of the electron by Sir J. J. Thomson in 1897,

has revolutionized several branches of physics. It seems destined to have revolutionary effects in meteorology, geology and astronomy.

A few weeks hence reprints of a forthcoming article on "Geological Evidence of Cycles" will be available, copies of which will be sent on request. Address 330 South Wells St., Chicago 6, Illinois.

Table 1—Lengths of Orbital Periods of Planets

| Cycle Series | Planet | Harmonic Period | Ephemeris Period |
|--------------|---------|-------------------|------------------|
| A & N | Mercury | 46/191 = 0.24083 | 0.24085 |
| E & M | Venus | 243/395 = 0.61519 | 0.61521 |
| D & K | Mars | 79/42 = 1.88095 | 1.88089 |
| G & J | Jupiter | 95/8 = 11.86250 | 11.86223 |
| H & I | Saturn | 324/11 = 29.45455 | 29.45772 |
| F | Uranus | 84/1 = 84.00000 | 84.01529 |
| B | Neptune | 165/1 = 165.00000 | 164.78829 |

Footnote: Uranus was discovered in 1781; Neptune in 1846. Table 2 gives lengths and peak dates of weather cycles caused by these planets.

Table 2—Lengths of Cycles in 14 Triple-Progression Series

| Series | Years | Years | Years | Years | Years | Years | Peak July 7 |
|--------|-------|-------|-------|-------|-------|-------|-------------|
| A | ... | 46 | 15.33 | 5.11 | 1.70 | 0.57 | 1928 |
| B | 165 | 55 | 18.33 | 6.11 | 2.04 | 0.68 | 1826 |
| C | 201 | 67 | 22.33 | 7.44 | 2.48 | 0.83 | 1883 |
| D | ... | 79 | 26.33 | 8.78 | 2.93 | 0.98 | 1907 |
| E | 243 | 81 | 27.00 | 9.00 | 3.00 | 1.00 | 1868 |
| F | ... | 84 | 28.00 | 9.33 | 3.11 | 1.04 | 1908 |
| G | ... | 95 | 31.67 | 10.56 | 3.52 | 1.17 | 1913 |
| H | 324 | 108 | 36.00 | 12.00 | 4.00 | 1.33 | 1636 |
| I | ... | ... | 29.46 | 9.82 | 3.27 | 1.09 | 1852 |
| J | ... | ... | ... | 11.86 | 3.95 | 1.32 | 1913 |
| K | ... | ... | ... | ... | 1.88 | 0.63 | 1907 |
| L | ... | ... | ... | ... | 1.00 | 0.33 | ... |
| M | ... | ... | ... | ... | 0.62 | 0.21 | 1842 |
| N | ... | ... | ... | ... | 0.24 | 0.08 | 1928 |

Footnote: The peak date of every cycle in a series is that in the last column on July 7 of the given year. The peak is that of maximum influx of solar electrons; and is usually a cold-wet peak, but in certain regions at times it is a warm-dry peak, the phase being reversed. Peaks are often marked by disturbances of the earth's crust. With the exception of Series C, no series has a cycle longer than is given in this table; but in Series C there are cycles, 3, 9, 27, 81, etc., times 201 years in length. The cycle of 81×201 or 16,281 years had its last cold-wet peak 2338 B.C., which was also a peak of all the subcycles of Series C. Its previous peak, 18619 B.C., was a peak of the Glaciation Cycle whose length is $9 \times 16,281$ or 146,529 years. The Glaciation Cycle has had three peaks in the Quaternary Age, the first being 311677 B.C., at the very beginning of the Quaternary Age. The cycle called a Geological Period has a length 9 times that of the Glaciation Cycle, and its last peak was at the beginning of the Quaternary Age. Each Series has cycles shorter than the shortest given above. For example, Series B has a cycle of 27.57 days, and cycles $1/3$ and $1/9$ of that length.

Back from Military Service

John P. Barnes, until recently a lieutenant with the 94th and 76th Naval Construction Battalion, has returned to Senior and Palmer, Inc., New York. Mr. Barnes had supervision of main-



J. P. Barnes

tenance, repair and assignment of construction equipment at Pearl Harbor and later on Guam.

Arthur H. Ritchie, a member of the firm of Boso & Ritchie, Inc., of Ravenswood, W. Va., has returned after spending 17 months in the ETO as Captain in command of the 1317th Engineer General Service Regiment.

Duane Austin Cullinan, who not so long ago was operating torpedo boats around Guadalcanal and Tulagi, has returned to resume his duties as partner in the firm of R. A. Cullinan & Son, Tremont, Ill. Mr. Cullinan held the rank of Lt. Commander, U.S.N.R.

Leo A. Vecellio, recently Maj. Corps of Engineers, with 10th Air Force in the China-India-Burma theater, is back with his own contracting firm, Vecellio & Grogan, of Beckley, W. Va. Mr. Vecellio was awarded the Legion of Merit and the Air Medal.

Ira E. Taylor, Major, Corps of Engineers, has returned to Dan Scherrer Construction Co. of Kansas City, Kans.

(Continued on page 110)

Now's the time to Spray your weeds away!



2-4D^{OW} Weed Killer

Kills weeds easily...completely...chemically

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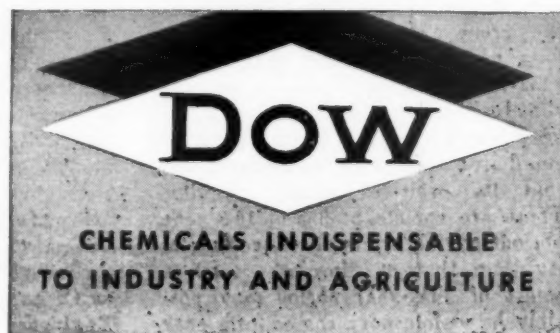
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2-4 Dow Weed Killer eliminates the troublesome job of hand digging, cutting and hoeing. Spray the weed *tops*—kill roots and all! Does not harm common grasses when used as directed.

Use 2-4 Dow Weed Killer wherever weeds must go so grass can grow—along roads and streets, in vacant lots, along telephone and power and railroad lines—on lawns, parks, playgrounds, golf courses, cemeteries and airfields. Available in powder or liquid form—packed in convenient sizes for every need.



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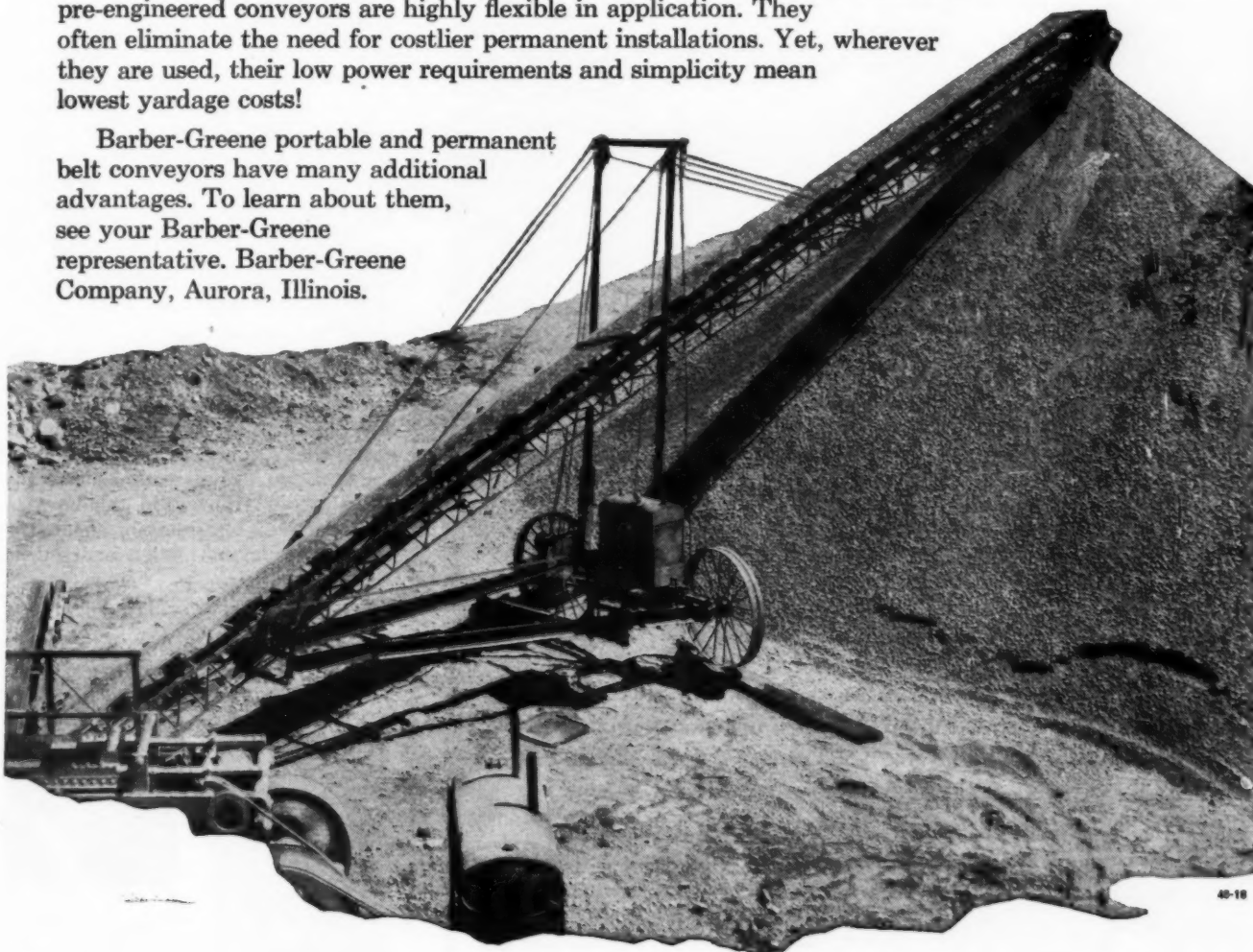
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- B-G portable belt conveyors keep materials on the move at a constant flow that means high daily capacity wherever they're put to work.

They can move all over the job, the quarry, the supply yard—stock piling and loading everything from sand to cement, crushed rock to coal.

Shortened or lengthened by the addition or removal of sections, these B-G pre-engineered conveyors are highly flexible in application. They often eliminate the need for costlier permanent installations. Yet, wherever they are used, their low power requirements and simplicity mean lowest yardage costs!

Barber-Greene portable and permanent belt conveyors have many additional advantages. To learn about them, see your Barber-Greene representative. Barber-Greene Company, Aurora, Illinois.



40-10



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(Continued from page 107)

Warren Dusenbergh for past 5 years vice president of E. M. Dusenbergh, Inc., grading contractors at Clear Lake, Ia., is back on the job. He served as a lieutenant with a Navy chartered transport in the Pacific theatre after V-E day, and previously served on a tanker in the Atlantic.

Stansell N. Byers, Major, has returned to the Oklahoma department's construction force.

Guy L. Benintend, on leave as treasurer of Ben Construction Co., Pittsburgh, Pa., is returning to his job after serving as Chief Warrant Officer, USNR, 92nd Construction Battalion with the Seabees in the South Pacific. P. A. Benintend, 2nd Lt., 21st Aviation Engineers in Africa and Europe, is also back with this firm.

Jim S. Thompson, who served in the ETO as a Captain on army communications, is joining his father, R. S. Thompson, road contractor at Oklahoma City.

Mail Inserted Card for Equipment Data

Again this issue of *Roads and Streets* carries descriptions of many new labor-saving efficiency devices and latest material developments. See our *Postwar Parade* beginning on page 122, for which a numbered reply card has been inserted to help you request data on items that interest you.

Nevada Department Has 158 Recent Veterans

Of the 180 men and women who left the Nevada state department of highways, 48 have returned to their old occupation, reports Robert A. Allen, state highway engineer, who states further, "In addition, we have 110 World War II and 66 World War I veterans and 5 Spanish American War veterans. We hope, within the next few months, to see all of the boys who left the Department back with us, who are able.

"Nine Gold Star men did not return.

"During the War period, the Department kept in touch with all of its former employees through the medium of a mimeographed document called the 'Flight Strip'. We were able to keep our organization cemented together and convey to the boys in the Service, information about the folks at home and their friends in the Service."

Eugene T. Scott has joined Templeton, Kenly & Co., Chicago manufacturers of Simplex industrial jacks, following his release from the Navy where he served as a lieutenant in naval aviation.



Eugene T. Scott

Leon A. Sherwood, Vice President, A. G. Sherwood Construction Co. of Independence, Kans., served as Lieutenant Colonel with the U. S. Engineer Department in the ETO where he participated in the Normandy Invasion and the Battle of the Bulge.

James Howard Galbraith, recently Motor Officer with 1308th Eng. Gen. Ser. Regt. in England, France, Okinawa and Korea is resuming his partner status with Staring & Galbraith, Oakland, Calif.

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but leaves little evidence of wear on this road built of REILLY BITUVIA



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Robert G. Larkin who spent 2½ years as a civil engineer with the U. S. Army Engineers in Africa and Asia is now located with Compania Constructora Groves-Drake, a Venezuelan subsidiary of the S. J. Groves & Sons Co., and Johnson, Drake & Piper, Inc., of New York.

Johnnie H. Johnson served as chief petty officer for 29 months in the southwest Pacific in charge of heavy equipment for the 63rd Naval Construction Battalion. Mr. Johnson has just returned to the constructing firm of Ulland Bros., Austin, Minn., as supt.



J. H. Johnson

William Harvey, Lt. Col. Army Engineers, is again with the Michigan department, on special work in the Detroit district. He served in the northwest, having had a responsible part in maintaining the Alaska Highway.

Lloyd J. Kissick, Jr., has returned with Kissick & Son, Hickman Mills, Mo., as Junior Partner, and will resume active duties around March 3. He was Lieutenant Junior Grade USNR, and spent 17 months in Hollandia, New Guinea, Mendora and Manila of the Philippines as communications officer.

Thomas F. Crumley resumed his position as Vice Pres. and Ass't. Gen. Mgr. of the Crumley, Jones & Crumley Co. on Nov. 29, 1945. Mr. Crumley served in Panama as Captain of Anti-Aircraft Artillery.



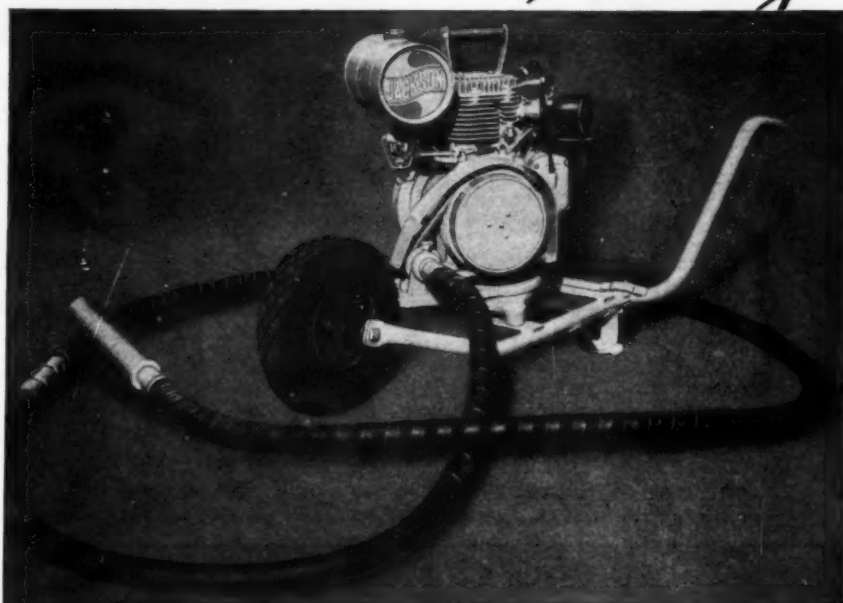
T. F. Crumley

Gail V. Ball, County Supt. of Highways, Cayuga County, N. Y., on military leave, has been Asst. Post Engineer at Indian Town Gap, Pa. Military Reservation; now Captain, Engineers. Served at Westover Field, Mass., and at Fort Belvoir, Va. At Westover he was largely engaged in snow removal equipment work.

(Continued on page 116)

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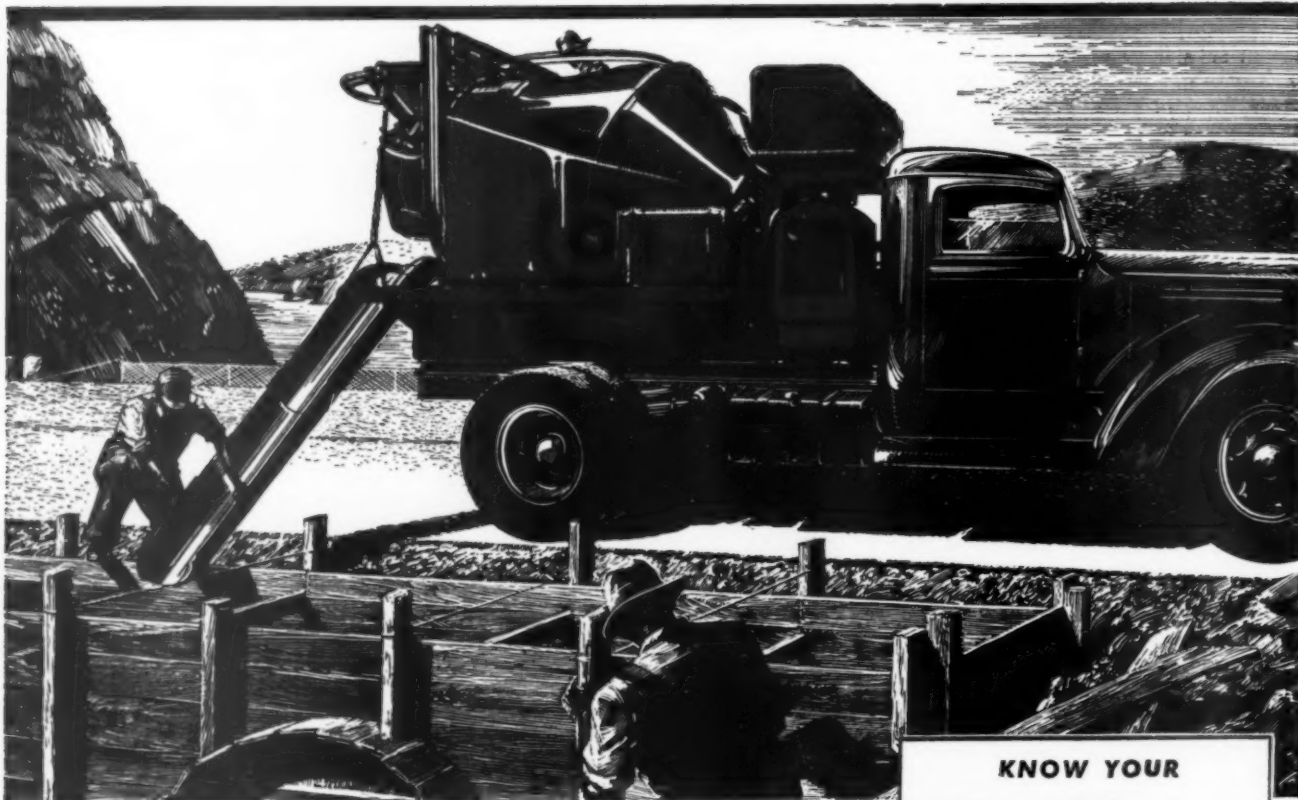
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Available with three standard vibrator heads for thin, thick and medium sections and powered by a husky, dependable Wisconsin engine, the JACKSON model FS-6A does a perfect job of handling the stiffer more economical mixes in an exceedingly wide range of operations. Flexible shaft (1½" core) is furnished in 7' to 14' lengths up to 28 ft. Unit has full swivel, dirt-proof base. Variable speed control up to 7500 V.P.M. Wheelbarrow with drop handles is optional. A highly advantageous unit for the general concrete contractor — built to the high standards of quality for which JACKSON equipment has always been famous. See it at your JACKSON distributor or write for complete information. The JACKSON line contains the best bet for every specific concrete vibratory purpose.

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Mo., Kansas City, Brown-Strauss Corp.
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N. C., Raleigh, Smith Equip. Company
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Importance of Consolidation in Airfield Construction

THE report of the soil compaction committee meeting sponsored by the American Road Builders early this winter, published in January "Roads and Streets," has evoked considerable correspondence and comment. We are indebted to W. R. Macatee, manager of ARBA's Airport Division, for a reminder of a strong plea for greater consolidation of pavements and subgrades, which was voiced by an engineer who had a leading part in wartime airfield engineering.

We quote the following extracts from a paper "Airport Construction," by Burton J. Bell, U. S. Engineer Office, Atlanta, given before the Association of Asphalt Paving Technologists, Dec., 1943:

"... In conclusion, let me call your attention to three *extremely important* 'must' rules to invariably follow in building flexible pavements. In our experience we have found if these rules are followed no failures occur. These are, in the order of their importance:

"First—Secure good compaction of all elements of the pavement, (a) embankments, (b) subgrade, (c) sub-base, (d) base, and (e) surface. This is extremely important in all cases, and especially so when heavy loadings—37,000 to 60,000 pounds—are to be applied. By all means—I can't express its importance too strongly—get consolidation by any methods you can; the point is, GET IT! I know of nothing that costs so little. I am told, proper compaction of subgrade, sub-base, base and surface courses probably costs, *all told*, less than 10 cents a cubic yard!

"I know of nothing which does so much to make a poor pavement as inadequate compaction of its different components. Don't ever fool yourselves that you can make up with expensive materials for lack of proper densification. I don't care how you get it—sheepsfeet rollers, scrapers, rubber-tired rollers, tractors, trucks, smooth rollers—whatever you can put your hands on—Get COMPACTION! It costs so little, and it does so much. By densifying all elements of the pavement when they contain the proper amount of moisture, we prevent subsequent consolidation by traffic, causing rutting and possible failure; and, importantly, we simultaneously reduce the voids to such extent there is little or no space left in

which moisture, from any source, may lodge. When subgrades and bases are properly densified they appear to be quite dry even though, in fact, they may be saturated. That is because there are so few voids, and a saturated condition is not the sloppy condition which the word may connote, and does not unduly lower the supporting power of a pavement which has been properly compacted. Remember, we require the same degree of densification of embankments, subgrades and bases under concrete pavements as is required under asphalt. Therefore, there is no advantage in competition with respect to this particular item.

"Second—In our experience we have found that the character of the material making up that portion of the base immediately under asphalt surfaces should be of a high order, preferably materials having 80-CBR-value. Indeed, for the heavy wheel loads 80-CBR is the minimum we permit. In some cases, where fairly good subgrades are encountered, and where 80-CBR-materials are not economically available, and when lighter wheel loads are involved, we permit the upper six inches of our base courses to be composed of materials which have CBR-values as low as 50%. Nevertheless, I always feel better if the upper portion of our bases is made up of 80-CBR-materials.

"Third—Adequate thickness is such a fundamental it would hardly seem to need mention. We have not been too conservative in our thickness requirements of flexible pavements to support wheel loads of a given maximum intensity for subgrades having a given support-value, as determined by the Porter Test conducted on soils which compose our subgrades. Flexible pavements can ordinarily compete successfully with rigid types of pavements, based on our design methods for the two types.

"These are the three fundamental 'musts' in considering how best to secure good results with the use of flexible pavements on airports. If we MUST sacrifice whatsoever—I believe I would prefer to toss away a portion—however, only a very small portion, if you please—of the thickness, in order to get the other two 'musts' in construction of flexible pavements on airfields, that is: (a) Adequate com-

(Continued on page 121)

PRA's New Procedure for Contract Concurrence

For the past several months there has been much confusion regarding the position of the Public Roads Administration as to current highway construction costs, observes a bulletin from American Road Builders' Association. First, the PRA inaugurated a procedure which required Washington

approval of all contracts which exceeded by 25% or more the levels of 1940 prices. Subsequently, the procedure was changed so as to require submission to Washington of contracts in excess of 35% of 1940 prices. As was feared this procedure created a rather muddled condition in the field

and occasioned delays which soon reached serious proportions. It was thus apparent that more flexible and lenient criteria would have to be established if the highway program was to avoid damaging delays.

Fortunately, PRA was quick to realize the seriousness of the situation and has just recently set up new criteria and procedures which will greatly expedite consideration and approval of projects. Under the new scheme jobs up to 35% in excess of 1940 prices will be concurred in by the PRA through their field offices in accordance with regularly established procedure. Projects which reflect prices between 36 and 50% in excess of 1940 levels can now be approved by Division offices of the PRA, but bids within this range will be subject to critical analysis and review.

In other words, where a project exceeds 35% of 1940 prices the District Engineer of the PRA is required to submit to the Division Engineer an analysis of the bids together with his recommendation as to approval. If the prices are not over 50% of the base period (1940) the Division Engineer is now authorized to concur in the award.

In all cases where the bid prices exceed 1940 levels by more than 50% the Division Engineer must send the project to PRA headquarters in Washington for final determination. This does not mean that all bids in excess of 50% will be rejected, but it does mean that all such bids will be subjected to critical review by PRA headquarters. It is therefore apparent that bids appreciably in excess of 50% will have to be supported by an analysis in sufficient detail to substantiate the prices.

Obviously, any such procedure involves a certain amount of red tape and delay. However, the PRA is making every effort to expedite the handling of projects which are sent to Washington. In this connection, however, it is well to bear in mind that the expediency with which PRA headquarters handles these projects will be largely dependent upon the adequacy of the analysis. It is therefore extremely important that the case be in proper shape before it is sent to Washington.

The PRA does not take the position that bids over 50% are necessarily excessive and therefore will be rejected. So far the PRA has approved the greater majority of cases submitted to them for review. On a dollar volume basis the PRA has concurred in over 65% of the work submitted for approval and on a project basis the percentage is substantially higher.




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Write for OTC Maintenance Bulletin showing some of many time-saving uses of OTC TOOLS.

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Fixin' 'em in the Field

Equipment servicing and repair methods as seen on the Shirley Memorial Highway with Nello L. Teer Co. (See article, pages 76 and 77, in this issue)



★ Replacement motors are trucked to the shop bolted to a castor-mounted stand. The Nello Teer shop mechanics have built a number of such stands, which save labor and protect the motor against mishandling and strain during loading and unloading from the truck



★ High pressure greasing lines, oil drum and diesel fuel drum are mounted on this truck

★ Even preformed rope eventually wears out and new rope must be drawn through the scrapers. Classical method of "cutting" cable shown here, just bend over the corner of the drawbar and mash it with a sledge

★ A wire brush for cleaning bolt threads is a useful accessory in making field repairs

★ One of the contractor's best investments is this carefully designed and especially built tool and repair truck. Note workman drilling for and driving rivets in weld repair of a brake drum, with help of vise on back end and power generated by a portable welding unit. The truck is equipped with an enclosed steel compartment holding bins for bolts, small parts and tools





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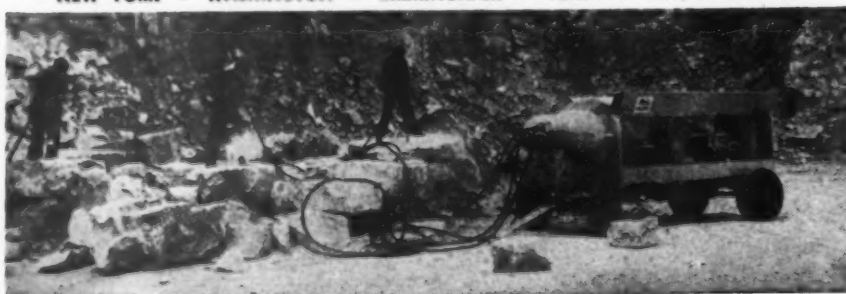
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(Continued from page 111)

L. T. Dyche, who served as a Lt. Col. in 323rd Air Service Group and later in the 9th Air Force headquarters, is back with the Oklahoma state highway department as right-of-way engineer.

Ernest W. McLaughlin, Major in U. S. Army Engineers, was discharged after 36 months in South Pacific, Australia, New Guinea, Philippines and Japan. He returns to the McLaughlin Construction Company, Livingston, Mont., as President.

Thomas K. McManus, while at West Point, rose to rank of Lieutenant Colonel. He will resume duties with Underground Construction Company, Oakland, Calif., as partner in May.

Archie L. Till, owner of the firm bearing his name, Yuba City, Calif., until recently Lieutenant Colonel, C. of E. in the ETO has returned to his business. Mr. Till won a citation for rehabilitation of port of Le Havre.

W. E. Orr, Jr., Lieutenant (CEC) USNR, has returned from service to assume full partnership in newly formed Orr & Orr Construction Co., Phoenix, Ariz., which organization replaces W. E. Orr Contractor.

The San-Ore Const. Co., McPherson, Kans., reports the return of their three Miller boys to civilian life. Clare Miller served as a Major 21 months in the C.B.I., and as an engineer worker on B-29 bases. Dale Miller was in the South Pacific as a Lt. Comdr., Seabees. Lloyd Miller was an army engineer, having been in Europe, Persia and the C.B.I.

(Continued from page 103)

sible, preferable not less than 6 in.

Directional signs should be at right angles to the direction of travel they are intended to serve. Signs set parallel with the direction of travel are difficult to read and this practice should be discouraged. Destination signs for places ahead on the route may be placed at right angles to the direction of travel by using vertical arrows to indicate that the direction is ahead.

The arrows on directional signs should be on the side of the sign corresponding to the direction of the arrow, i. e., a left arrow should be on the left side and a right arrow should be on the right side. This will minimize confusion as to the direction in which the arrow points. Vertical arrows should be on the left side.

CONTRACTORS

HERE ARE FACTS ABOUT FINANCING CONSTRUCTION EQUIPMENT

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New York State Highway Notes

New York State's scoreboard of 1946 highway lettings was scheduled to pass the 20 million dollar mark in April, with 8½ million bids received on April 17. Another 130 million yet to go this year.

Full responsibility for snow and ice control on all state highways is recommended in a bill before the New York legislature. It provides that the state absorb full costs but expresses preference for the work to be performed by the counties. The

counties, which presently remove snow from state roads under contract, would subcontract snow removal on urban sections with towns and villages, or do such work with maintenance crews.

A new bureau known as the city arterial route planning bureau has been established in New York State. Fred W. Fisch and Edgar B. Shrope have been appointed principal planning engineers in this bureau, which will assist in the development of plans for state-financed urban sections of arterials.

(Continued from page 84)

of the dynamic modulus of elasticity of concrete, and our technicians are now familiarizing themselves with its use. In my opinion, this equipment offers untold possibilities for the study of concrete and concrete materials from the standpoint of durability, and we intend to make the utmost use of it.

A study of properties of air-entraining cement, pursued recently on a small scale, undoubtedly will continue. Opportunities for field observations will be more numerous than heretofore, since the use of air-entraining cement is now required within all municipalities.

Research relating to bituminous construction, carried on recently on a very small scale, no doubt will be continued at an increased tempo.

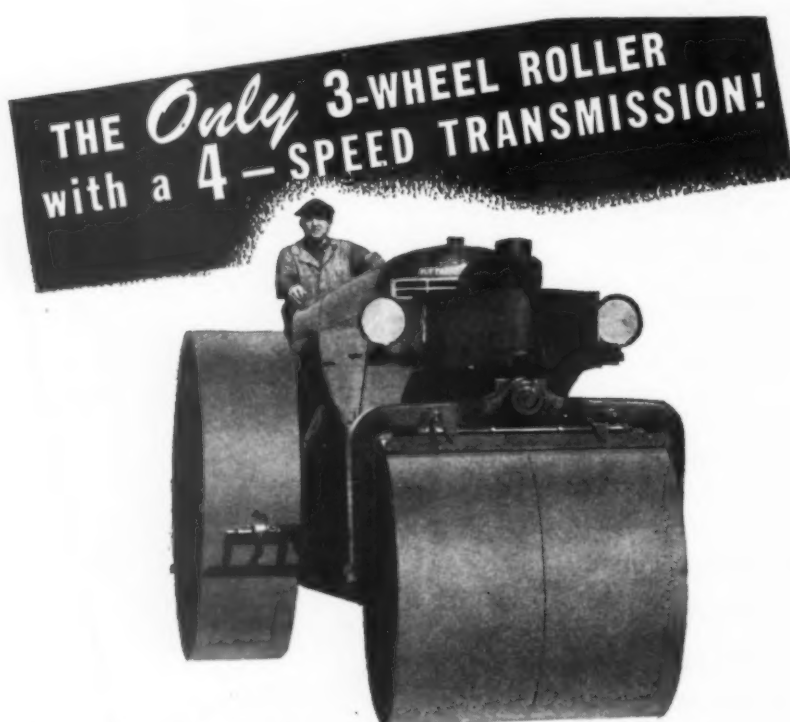
Oklahoma Projects

B. E. Clark, federal-aid engineer, Oklahoma highway commission, reports that research is being expanded on city traffic investigation, economy of local materials, subgrade design and stabilization of subgrades and shoulders.

Clear Order for Roads No Surprise

The fact that highway agencies were given carte blanche authority to go ahead on road and bridge construction under present restrictions was no surprise to anyone who gave the matter second thought. We are referring to the resumption of wartime controls which forbid continuance of building construction work not begun on March 26.

Yet the urgent need of highways does not always speak for itself, and the industry is indebted to all spokesmen who have steadfastly maintained that highway and highway bridge construction should be exempt. The reasons, as maintained by the American Road Builders' Association, are: (1) Highway improvement so long delayed because of the war could not be further deferred without disastrous results; (2) There would be no conflict between the contemplated housing program and the road program because highway construction would only require an insignificant amount of materials essential to home construction; (3) The economic development of our nation and the attainment of a high level of prosperity during the postwar period is largely dependent upon highway development; and (4) The appalling



The Buffalo-Springfield

forward and reverse 4-speed transmission provides a speed range from 1.5 to 5.0 M. P. H. so that you can select the speed to fit the job without throttling the engine. This means full engine power at all times! Operation is more efficient and rolling is smoother. This transmission is not complicated. It has fewer shafts than conventional three-speed transmissions! Ask for 16 page catalog describing 13 points of superiority.

- Three Wheel Rollers—6 to 12 tons
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The Oldest and Largest Builder of Road
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Mail Inserted Card for Equipment Data

Again this issue of *Roads and Streets* carries descriptions of many new labor-saving efficiency devices and latest material developments. See our *Postwar Parade* beginning on page 122, for which a numbered reply card has been inserted to help you request data on items that interest you.

increase in highway fatalities since the end of gasoline rationing demonstrates the immediate need for removing hazards and providing safer highway facilities.

Substantially the same position was taken by several topside federal agencies in their efforts to keep the highway program from being hamstrung. General Philip B. Fleming, FWA Administrator, in a recent statement on the subject, said: "Highways are traffic arteries essential to the economic wellbeing of the nation and after four years of deferred maintenance during the war remedial construction cannot safely be further postponed. Such construction is of direct benefit to the returning veteran without depriving him in any degree of either the man or materials needed to build houses."

Airport Restrictions

Airport construction, however, did not fare so well. As the order now stands specific authorization must be obtained from the Civilian Production Administration before airport projects can be undertaken. Just why the distinction was made between highway and airport construction is not plain but the ARBA takes the position that an airport program such as contemplated will not compete or interfere with the building of homes for veterans. Efforts are now being made to obtain an exemption for airport construction which will be unnecessarily hampered by the terms of the order.

In announcing the issuance of the new order, Administrator Small explained that the CPA is setting up in each of the Federal Housing Administration cities a CPA construction office. Associated with each of these CPA offices will be an advisory committee of citizens in the community; one recommended by the mayor or governor, one from the ranks of general business, a representative of builders and building materials, the press, and the district manager of the Federal Housing Administration. These committees will review all applications and make

recommendations regarding approval. Criteria to be used in determining approval include: (1) Essentiality of the proposed job in relation to the veterans program; (2) Essentiality with regard to the elimination of the bottleneck in reconversion; (3) The public health and safety of the community; and (4) Unusual and extreme hardship.

Kentucky's three remaining toll bridges recorded highest monthly tolls in history during recent winter months. Milton-Madison bridge averaged over \$9,000 monthly, about 60% ahead of 1942. Another bridge count

was up 160% in January compared with two years ago.

Lefebvre Appointed Arizona State Engineer

W. C. Lefebvre has taken up his new duties as state engineer of Arizona, having come to the post from the Navy to succeed Bernard Touhey who has entered private engineering practice.

Mr. Lefebvre has held this post before and also at one time headed up Public Works Administration in Arizona and served as city manager of Phoenix.

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The Right Beginning for Better Roads!

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Secondary roads that meet requirements at lowest cost can be built by local labor, of local soil materials, consolidated with calcium chloride.

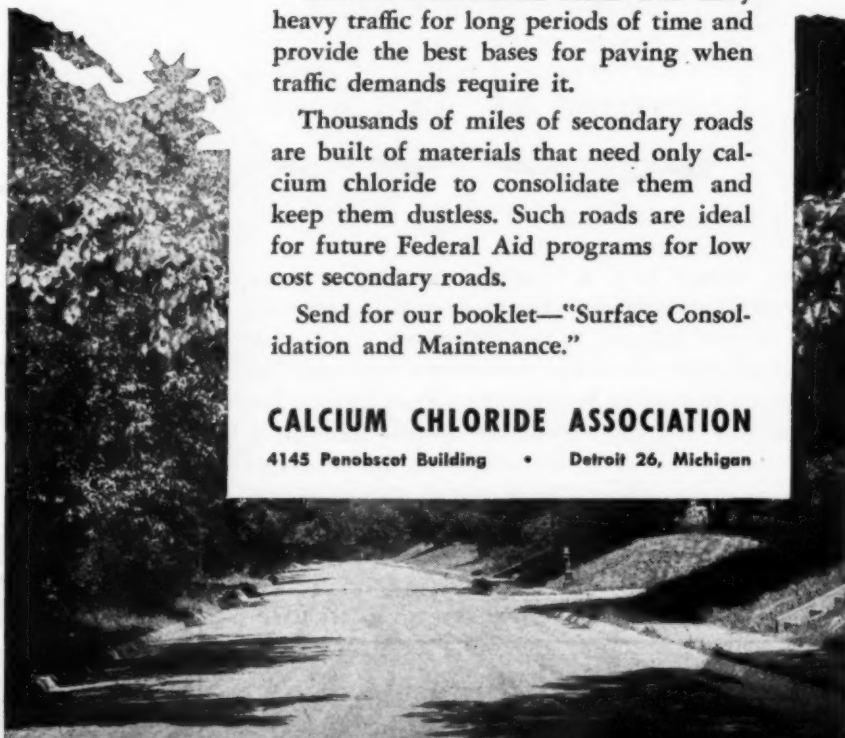
Calcium consolidated roads will carry heavy traffic for long periods of time and provide the best bases for paving when traffic demands require it.

Thousands of miles of secondary roads are built of materials that need only calcium chloride to consolidate them and keep them dustless. Such roads are ideal for future Federal Aid programs for low cost secondary roads.

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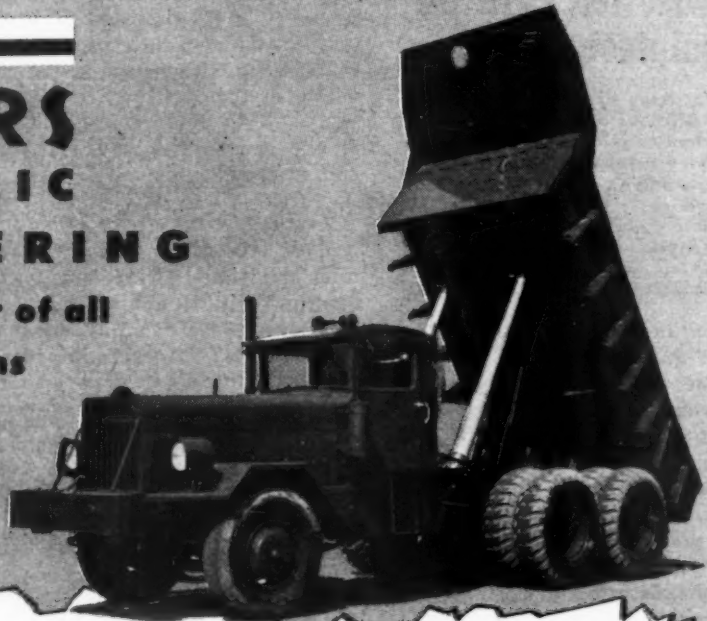
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The chassis illustrated is one which has been developed for off-the-road operations and built to carry 30 ton payloads. Chassis of this type are called upon to operate over rough terrain under adverse conditions, demanding the most efficient steering mechanism available. For that reason, we equipped this chassis with the Vickers Power Hydraulic Steering Booster, which relieves the driver of all steering strains and makes it possible for him to work long hours without exerting undue effort.

This excerpt from a letter by the Sterling Motor Truck Co. mentions the advantages of Vickers Hydraulic Power Steering to the driver but it does not indicate how easily and conveniently this equipment can be applied to most existing chassis designs. The separate and compact power cylinder (booster) is connected to the drag link at one end and the chassis frame at the other; it is controlled by the pitman arm. The existing steering gear is not altered.

There are many other advantages of Vickers Hydraulic Power Steering. Write for Bulletin 44-30 which gives all the facts.

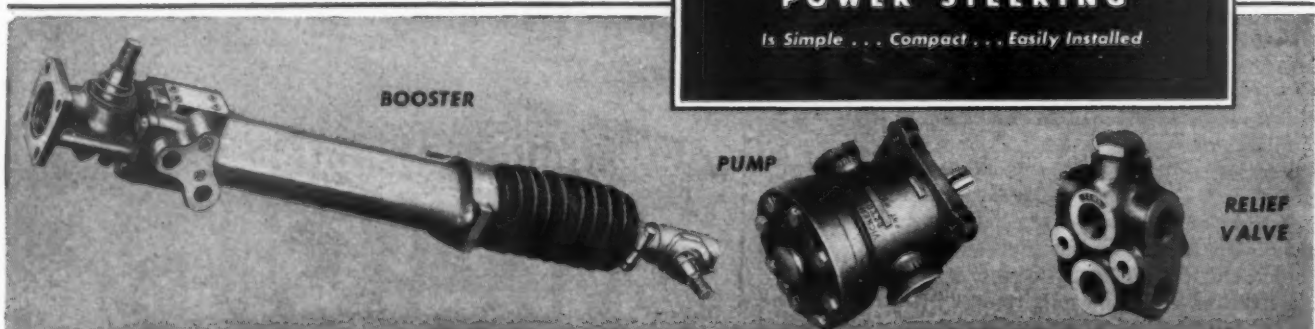
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Is Simple . . . Compact . . . Easily Installed



(Continued from page 113)

paction—not just a lick and a promise—and, (b) high quality materials immediately under the surface course.

"In the pressure of wartime requirements, we have learned these and many other things that will continue to be helpful to the paving industry during the years of peace that lie ahead."

Yale Announces Traffic Engineering Fellowships

Ten Graduate Fellowships in Traffic Engineering are announced by the Bureau of Highway Traffic of Yale University. These Fellowships amount to \$1400 each and provide for a full academic year of graduate study beginning September 23, 1946. The Fellowships have been made possible through a grant to the Bureau of Highway Traffic from the Automotive Safety Foundation.

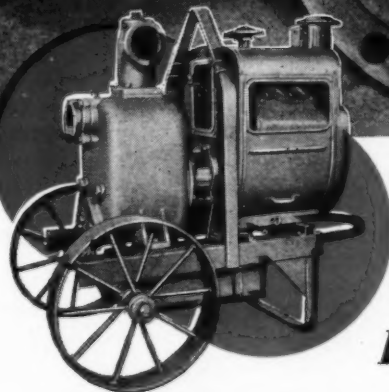
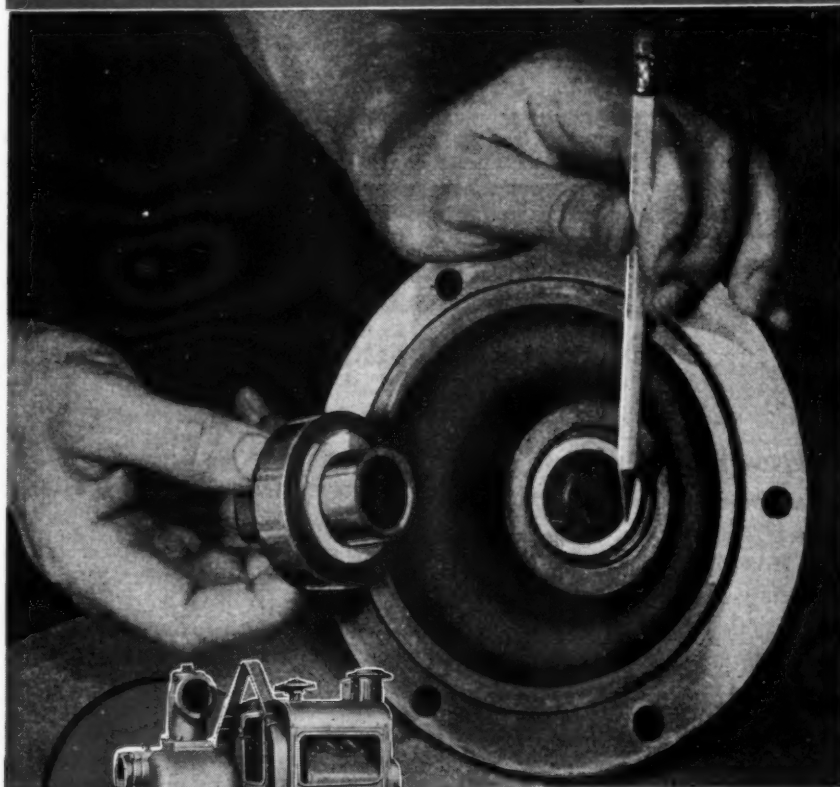
This graduate course in Traffic Engineering provides a broad foundation in the techniques of highway traffic operation and is designed to give the student increased skill and ability in the analysis of traffic problems and a thorough knowledge of traffic engineering.

Theodore M. Matson, Director of the Yale Bureau of Highway Traffic, in announcing the availability of Fellowships stated: "There is an increasing need for professional traffic engineers in highway traffic work, in view of the acute street and highway transportation problems which now exist in nearly every community and which show every promise of growing worse before relief can be obtained." "Because of accidents and congestion, traffic operations are being given increased attention by state and municipal officials.

Fellowship awards are open to men who have been granted an engineering degree by an accredited college. "In addition to those who are successful in competing for the Fellowship awards the course is open to qualified veterans under provisions of the G.I. Bill of Rights," Mr. Matson stated. As in former years, it is also expected that there will be students from city or state highway departments who will enroll either on their own or with some financial support made possible through special assignment by their employers.

The closing date for applying for Fellowships is June 1. Additional information concerning the course and Fellowships may be obtained by writing to the Bureau of Highway Traffic, Yale University, New Haven 11, Connecticut.

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● The seal that keeps the water in and the air out consists of two wearing surface seal rings made of Tungsten Carbide and a grease container. One seal ring rotates on the shaft and is held in contact with the stationary ring by a stainless steel spring. This method of sealing is specially suited for high pressure work and when handling dirty water—the higher the pressure the tighter the seal. Dirty water cannot get into the grease and damage the shaft and bearings. Air is kept out of the pump so there's no loss of vacuum and high priming efficiency is maintained.

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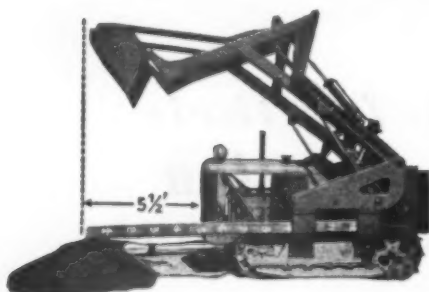


Postwar Parade

of New Construction Equipment and Materials

New Front End Loader

1. A new front end loader has been brought out by Drott Manufacturing Co., Milwaukee, Wis. Designed for mounting on Oliver Cletrac crawler tractors, the loader has a lift of approximately 10 ft. 8 in., and dumps its load about 5 ft. ahead of the radiator. The standard bucket has a ca-



Drott Hi-Lift Loader

capacity of 1 1/4 yds. A light material handling shovel of 1 1/4 yds. is available. The unit is hydraulically operated, using the Drott closed hydraulic system with no air vent to allow air or dirt to enter nor oil to escape. It is equipped with a front-mounted pump.

New Truck Tire

2. A new type truck tire with special tread design to meet needs of vehicles that operate both on and off the highway has been put into production by The Goodyear Tire and Rubber Co., Akron, O. The new tire, known as the Hi-Way Lug, has a deep, non-skid and extra heavy tread plus strength in the rayon cord body to provide cut and bruise protection as well as traction and wearing qualities. This tire is made specifically for oper-

ations demanding tires built to go in off the road, bring out the load and then to complete the hauls on hard surfaced roads. The lugs are placed close together for smooth-rolling and long, even tread wear. The alternate long and short bars provide extra traction when "in the rough." Specially compounded rubber toughens the tires against road shock and guards against separation and blow-outs. Construction provides effective resistance to cutting, snagging and bruising.

New Accounting System for Contractors

3. A new accounting system recently designed and produced by Tallman, Robins & Co., Chicago, Ill., combines the accounting records with a job record, payroll, cost information and tax data all into one convenient unit. Outstanding features of the system are its use of building terms and items not only in the instructions but also in the printed headings of the forms themselves; its "Job Memoranda" for jotting down important data for use on figuring future jobs; its presentation in easy form of all facts and figures so that figuring income and other taxes is simplicity itself; and most important of all, the entries on the "Job Record" are set up in such a manner that actual costs of each job may be compared with the estimated costs so that variations are noticed at once.

Mail Inserted Card

for data on equipment
described on these pages

New Slide Rule

4. A 10 in. slide rule made of transparent plexiglas has been brought out by Pereles Brothers, Milwaukee, Wis. It is stated this product is not affected by temperature changes or humidity or other factors which formerly affected wooden devices. Calibrations are molded in during manufacture, assuring long life and accuracy.

New Shovel and Crane

5. A new shovel and crane, the TL-20, stated to embody many new engineering and design principles, has been announced by The Thew Shovel Co., Lorain, O. The TL-20 can be equipped with a choice of five interchangeable booms and 10 different types of mountings. An important feature of its turntable design is the Unit Assembly principle which enables each major component, the



TL-20 Shovel-Crane Unit

clutch shaft, the cab, the engine and accessories, and the hoist shaft, to be removed as a unit and replaced with a similar complete unit. Other turntable features include one piece, all-welded turntable beds, hook rollers, extensive use of anti-friction bearings, cut gears throughout with all

gears except two intermittently used gears running in constant oil bath. All five shoe-type clutches controlling the unit are mounted in one "unit-assembly" and are interchangeable. Power is transmitted from this clutch shaft to other functions by noiseless roller chains. The TL-20 may be mounted on either crawler or with rubber-tire mountings. Single engine, self-propelled units in both 4 and 6-wheel types are available. The single turntable engine powers all turntable operations and also propels the unit. There are four speeds forward and reverse with a speed range up to 7½ miles per hour.

New Spraying Machine

6. A new automatic spraying machine which is stated to eliminate "guess" work in the application of curing compounds on concrete roads has been developed by Flexible Road Joint Machine Co., Warren, O. It is stated this machine double sprays each square foot of surface evenly and completes its work before drying and hair cracking can develop. Machines are adjustable for single and two-lane construction. Single lane machines are adjustable from 10 to 12½ ft.; two lane machines from 20 to 25 ft. A gasoline engine delivers the material under pressure to the nozzle and propels the machine. Optional with the machine are: A hoist for lifting the drums; a fabric surface finishing drag, placed in front of the machine; and an automatic brooming attachment to produce a broom finish.

New Tractor Shovel

7. A new model has been added to the line of Traxcavators of the Trackson Co., Milwaukee, Wis. This Model IT 4 mounts on and is powered by the "Caterpillar" Model D 4 track type



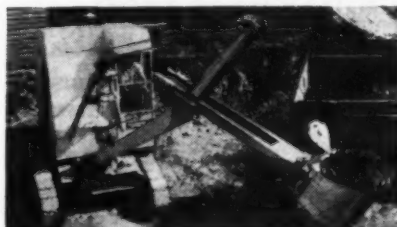
Model IT4 Traxcavator

tractor. The new model is stated to include many improvements. The

standard bucket is 1 cu. yd. capacity. It is wider than the tractor tracks so that it will trim closely alongside curbs and walls. Bulldozer blade can be installed quickly in place of bucket. Angle-grader and other attachments are available. The tractor drawbar is always free for hauling work. The mechanical-hoist is driven from the front power take-off of the tractor through a reliable V-belt drive, so is independent of the tractor clutch and transmissions. Bucket can be dumped from any point of the lift and has a digging range from 14 in. below track line to 56 in. above . . . is tilted back 30 degrees during the first part of lift, minimizing spillage and delivering a full load.

New ¾-Yd. Shovel

8. A light, fast ¾-yd. excavator, which has partial swing operating advantages, has been announced by The Byers Machine Co., Ravenna, O. The unit weighs 8¾ tons complete. It has 37.5 hp. industrial type motor,



Byers Junior Excavator

15 ft. 3 in. boom, 10 ft. 4 in. dipper stick and full ¾ cu. yd. dipper. Excavator operator and all working machinery are located on the non-weaving 14 in. deep structural main frame and do not swing with the boom. Because gears, clutches, drums and shafting are set low on the main frame, an unusually low center of gravity results and increased resistance against tipping is assured when excavator is working on sloping ground and when heavy crane loads are being lifted. Fully enclosed cab, new dipper trip, worm and gear boom hoist, oversize clutches all of the same size with interchangeable linings and self-cleaning crawler treads are other features of the unit.

New Truck Models

9. The 1946 Model FWD, now under production by the Four Wheel Drive Auto Co., Clintonville, Wis., are being built in three major weight classifications ranging from 3 to 15 tons rated capacity. Trucks in the H series line, classified as light-heavies,

are rated at 3 and 4 tons capacity. U series are being built in the 5-ton classification. The company's M series line of trucks are being built with 10 tons rated capacity. FWD six wheel drive tractors and trucks rated at 15 tons capacity are also included in the company's standard line



Model M7 FWD Chassis

and are listed as available for immediate delivery. The 1946 FWD has been completely restyled for improved appearance and utility. Salient features of this restyling include modernized radiator grills, streamlined fenders and skirting, and the new, more comfortable "Universal Safety Cab." Axles, transmissions, and frames have been redesigned and re-engineered for greater safety, greater speed, and greater durability. Built on mass production assembly lines, the company's listed models are all of standard design and can be equipped for use in all heavy duty trucking work.

New Portable Drinking Fountain

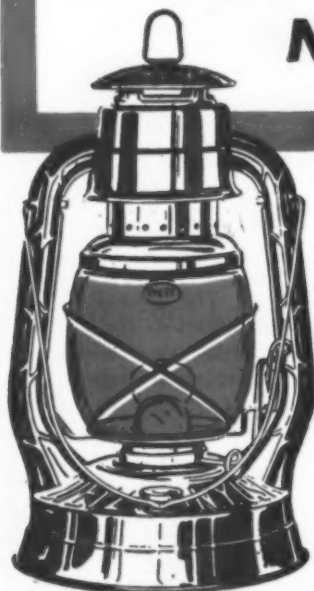
10. A new portable drinking fountain fitted with a salt dispenser, to provide fresh water for gangs in the field, has been placed on the market by Dobbins Manufacturing Co., Elkhart, Ind. The portable equipment consists of a tank



New Portable Drinking Fountain

DIETZ LANTERNS

Now Under Way



Please accept our gratitude for your patient cooperation during the days of war needs and consumer scarcity. We are getting under way for normal production.

NOW Turned
Coated
Steel



Finished in
Gray
Enamel

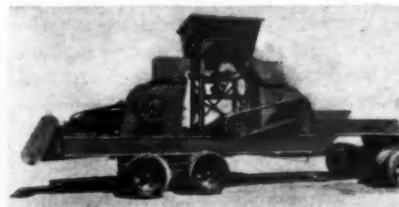
R.E. DIETZ COMPANY
1840 **NEW YORK** 1946

OUTPUT DISTRIBUTED THROUGH THE JOBBING TRADE EXCLUSIVELY

with a capacity of 4 gal.; a built-in, corrosion-proof bubbler of the tilting type, which is concealed inside the fountain to prevent freezing; a water-release knob which requires only slight pressure to provide the desired flow of water; and a pump equipped with a valve plunger, which provides air for the necessary water pressure. All fountains are equipped with loops for carrying straps and are fitted with mounting brackets for salt-tablet dispensers, each of which will hold 500 tablets. Among the advantages claimed for this equipment is that it does away with the common drinking cup; that the water is sealed from contamination by dust and dirt, so that the men get it under sanitary conditions; and that the provision for the salt tablets will reduce the incidence of heat prostration.

New Portable Pulverizing Plant

11. A new portable pulverizing unit for fast, large scale, economical aglime production has been announced by the Universal Engineering Corporation, Cedar Rapids, Ia. It consists of feed hopper with mechanical plate feeder,



Tandem Portable Aglime Plant

which feeds material uniformly to the two Universal pulverizers, mounted on the chassis beneath, one on each side of the hopper. Pulverizers of various sizes are available on this unit. Pulverizers have V-belt drives and reversible manganese steel hammers and liners. Crushed material is conveyed by channel frame under-conveyor. Rugged gooseneck chassis is built with dual tires and rear axle equalizer. Can be had as semi-trailer, as shown, or as full truck.

New Drafting Devices

12. Two new time-saving drafting devices, made of the transparent plastic, plexiglas, have been placed on the market by Dolgorukov Manufacturing Co., Washington, D. C. The "hatch-liner," used for doing rapid and uniform section lining, consists of a 45° triangle and a small irregular octagonal shaped "center piece" which

STEEL REINFORCING



AIRPORTS



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BRIDGES

CULVERTS

For Real Service —

LET LACLEDE SUPPLY YOUR REINFORCING NEEDS FOR CONSTRUCTION OF HIGHWAYS, BRIDGES, AIRPORTS, CULVERTS AND DRAINAGE STRUCTURES. DELIVERY IS MADE TO THE JOB SITE WHEN NEEDED — COMPLETELY ENGINEERED AND DETAILED — READY FOR PLACING. A FULL LINE OF REINFORCEMENT IS AT YOUR SERVICE.

Depend on Laclede

LACLEDE STEEL COMPANY

GENERAL OFFICES

ARCADE BUILDING

ST. LOUIS, MISSOURI

fits into the central opening of the triangle. The "center piece" is numbered to indicate the various positions in which it can be placed to achieve desired spacing of section lines. The Plexiglas "slot-letter", is a guide which enables draftsmen to do a free-hand lettering job. Lettering is done directly through one of the slots, with the aid of reference lines engraved on the guide to insure proper inclination.

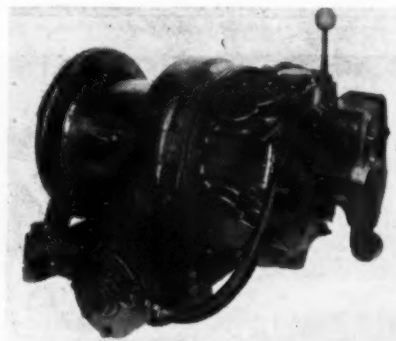
New Decarbonizing Cleaner

13. A heavy duty metal parts cleaner, developed by the Magnus Chemical Co., Garwood, N. J., for the Army Air Force during the war, is now available for civilian use. The product "Magnus 755," was used by the Air Force in cleaning combat aircraft engine parts during reconditioning. It is stated that when experimental work began, the Army Air Force cleaning cycle on engine parts was 4 hours, but Magnus 755 cut this down to 1 hour. It is claimed that the rapid, penetrating action of Magnus 755 makes it a time-and-labor saver in cleaning all carbonized, dirty

and gummy parts. Magnus 755 is optionally obtainable in a handy dip-tank container. The unit consists of 4 gal. of Magnus 755 in a 5-gal. container (to allow addition of the water seal), and a sturdy, welded parts dipping basket.

New Safety Feature on Hoist

14. An important safety feature on a hoist has been announced by Gardner Denver Co., Quincy, Ill. This fea-



Safety Brake for Hoist

ture available on the Gardner-Denver Model HKK hoist, consists of a spring-loader brake, which is held in

the off-position by air pressure. If the air supply fails for any cause, if an air hose rupture or a line breaks, this brake is automatically applied. The brake is automatically released when the throttle valve is moved in either direction. The throttle valve will automatically return to the neutral position when released by the operator. This new brake is positive and entirely automatic. It will hold in suspension any load within the capacity of the hoist and cannot be released until air is admitted to the motor and the load is picked up.

New Sickle Blade Sharpener

15. A sickle blade sharpener has been added to the line of mainte-



Edgemaster Sickle Blade Sharpener



You can increase efficiency and simplify operations of almost any type of equipment by making it portable. Investigate the uses of EWC Wheels, Axles, Springs, Tongues, etc., to give your equipment added value.

Write today for Illustrated Bulletins, and for sound engineering help based on more than half a century of experience.

Make Your Machines Mobile with EWC Mountings

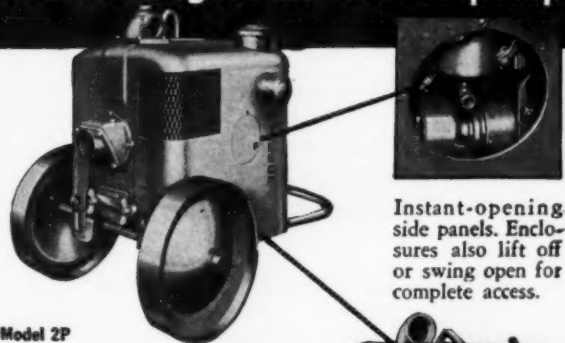


Electric Wheel Co., Dept. RS Quincy, Ill.

EWC WHEELS

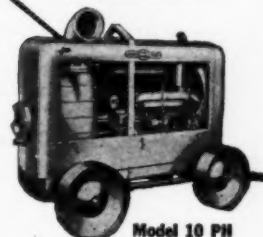
ENCLOSED YET FULLY ACCESSIBLE

JAEGER "SURE PRIME" design now insures efficiency and long life for engine as well as pump



Model 2P

Keep the weather off the engine and move more water with your pump—that's one of the post-war improvements Jaeger alone gives you, along with doubly sure priming and "better than guaranteed" performance in the world's largest selling line of pumps. Ask for Catalog P-45.



Model 10 PH

THE JAEGER MACHINE CO. Main Office, Factory
Columbus, Ohio
REGIONAL 8 E. 48th St. 226 N. LaSalle St. 235-38 Martin Bldg.
OFFICES: NEW YORK 17, N. Y. CHICAGO 1, ILL. BIRMINGHAM 1, ALA.

MIXERS • COMPRESSORS • HOISTS • LOADERS • PAVING EQPT.

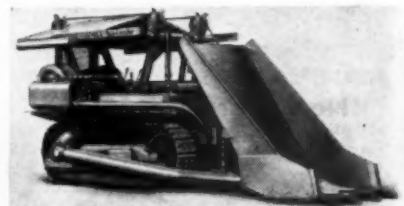
nance equipment of Pneu-Hydro Road Machinery Co., Cadillac, Mich. It is constructed of 2 in. pipe and heavy gauge steel and has over-all dimensions of 4½ ft. by 8 ft. Motive power is from a ¼ hp. electric motor which drives the grinding wheel at a speed of 3500 rpm. The wheel is beveled to sharpen two cutting edges at one time and the entire grinding unit swings in a 30° arc. Three clamping devices hold the sickle blade in correct alignment on the table. The table rocks on a pivot, is completely under finger-tip control, and when operator's touch is removed the table

automatically drops to avoid accidental contact with wheel. Wheel guard can be reversed to act as holder for wheel dressing tool, providing quick renewal of grinding surfaces.

New Tractor Shovel

16. A new MobilLoader, Model W4-5, has been added to the line of Athey Products Corporation, Chicago, Ill. It is engineered for "Caterpillar" wide gauge D4 tractors. It has single finger tip control that results in the instant response of the full power of

the tractor. The overhead loading principle of straight-line production is retained in this machine. Improvements in design are stated to result in greater visibility and its streamline mounting permits full accessibility to the tractor engine. Weight saving has been incorporated with strengthened design of parts subject to greatest stress. Particular attention has been given to a balanced



Model W4-5 MobilLoader

mounting on the tractor for greatest traction and minimum wear on idlers and rollers. Interchangeable bucket equipment is available in sizes for various types and weights of materials. In addition, an interchangeable bulldozer blade can quickly be installed on the left arms.

New Magnetic Drill Extractor

17. A new magnetic device for removing drill bits, diamond bits and broken drill rod from rock drill holes has been introduced by the Dings Magnetic Separator Co., Milwaukee, Wis. Made of a new type of Alnico magnet steel, said to have nearly twice the magnetic strength of older Alnico steels, the drill extractor is capable of lifting approximately 25 times its own weight in vertical lifts, and exhibits unusual holding ability on small and uneven surfaces. The extractor weighs only 1 lb. and is made in 1¼ in. and 1½ in. diameters. In use, it is fastened to the face of an old drill bit and put into the drill hole at the end of a length of drill rod or wooden pole. Because of its small size, it can easily be carried in the driller's pocket until necessity for its use arises.

MANUFACTURERS' LITERATURE

Motor Grader

18. The J. D. Adams Manufacturing Co., Indianapolis, Indiana, has announced the publication of a new

POWER PLUS! THAT'S SYNTRON

GASOLINE HAMMER

PAVING BREAKERS

Busting concrete
Cutting asphalt
Digging clay and shale
Tamping backfill

A really SELF-CONTAINED demolition tool — requiring no air compressor or battery for operation.

—utilizing the explosive force of gasoline to drive a free hammer piston against the shank of the tool—2,000 blows per minute.



Write for Folder 8-45

SYNTRON CO.

384 Lexington,

Homer City, Pa.

catalog covering their model No. 512 motor grader. This machine, the first new post-war motor grader produced by Adams, incorporates many new features in design. The new "high-arch" front axle and full-floating rear axle are featured. The grader is the product of over five years of intensive research and experimental work and has been thoroughly "job tested" on every type of road building work.

"Caterpillar" Products

19. "Manufacturing Excellence" is the title of a 16-page illustrated booklet published by Caterpillar Tractor Co., Peoria, Ill. The publication teams performance records of the finished product with the manufacturing details which go to make it and portrays, editorially and pictorially many of the manufacturing machines, processes and details which develop "Caterpillar" products. The illustrations include pictures of the finished products in their various fields of operation, where the values of manufacturing methods are tested under the stress of the job.

Shovel, Crane, Dragline

20. The Lima Type 1201 shovel, crane, and dragline is described in a new bulletin of the Shovel and Crane Division of Lima Locomotive Works, Inc., Lima, O. The bulletin features the application of "Precision" air control, and also describes many other Lima advantages, with illustrations of complete machinery and views showing the machine in a wide variety of jobs.

Rollers

21. A new 16-page catalog describing its 10-ton and 12-ton three-wheel rollers has been issued by Buffalo-Springfield Roller Co., Springfield, O. Illustrations show clearly the unit assembly of engine, transmission, differential, clutches, and final drive pinions; the top air intake; four-speed transmission and other elements of design. Specifications are included.

Rear and Bottom Dump Bodies

22. Two new catalog folders on rear-dump and bottom-dump Euclid Models have been issued by The Euclid Road Machinery Co., Cleveland, O. Form No. 101 features the Model F 15-ton rear-dump Euclid for

off-the-highway hauling of earth, rock, ore and heavy excavation. This model has a struck measure capacity of 9.7 cu. yds. and a top speed loading of 22 m.p.h. The 13 cu. yd. bottom-dump Euclid is covered in Form No. 201 which contains illustrations and specifications of this model. Designed for big jobs, this Euclid has a payload capacity of 40,000 lb. Maximum speed loaded is 26 m.p.h. Both of these folders incorporate more complete specifications and technical information than the catalogs which they supersede.

Bulldozers

23. Recent newcomers in the "Caterpillar" line of products, the No. 8 S and No. 7S (straight type) bulldozers are featured in a new broadside published by Caterpillar Tractor Co., Peoria, Ill. The broadside describes and liberally illustrates these new bulldozers designed and built for exclusive use with "Caterpillar" Diesel D 8 and D 7 Tractors. Various features of the equipment are illustrated and described and specifications are given.

workability

durability

and controlled air

with DAREX AEA

Improved workability with Darex AEA will save money. Improved workability makes concrete easier to place and permits quicker finishing. Darex AEA improves the durability of the hardened concrete with little or no loss in strength. With Darex AEA you have complete control of the air content, regardless of the nature of the aggregate used, the richness of the mix, or the length of time of the mix. Darex AEA is not supersensitive. It is safe. It comes ready to use. It is inexpensive.

simple proportioning equipment available

To facilitate use of Darex AEA, simple devices for proportioning have been designed. Blueprints are available, or we can supply you with the proportioners. Use Darex AEA and get workability, durability, and controlled air entrainment. *Write for booklets.*

DEWEY AND ALMY CHEMICAL COMPANY

CAMBRIDGE 40, MASSACHUSETTS

Electric Light Plants

24. Its line of Katolight plants is described in a circular just issued by Kato Engineering Co., Mankato, Minn. In all 12 portable plants, ranging in capacity from 240 watts to 25,000 watts are illustrated and described.

Photocopying Equipment

25. Equipment for making photo-exact facsimiles of drawings, graphs, charts, letters, etc., is described in a catalog issued by American Photocopy Equipment Co., Chicago, Ill. This machine can be used for making photocopies direct from blueprints without need of tracings and for making usable new copies of old tracings. Photographic tracings can be made direct from any blueprint, drawing or sketch.

Portable Generators

26. The completely new line of portable gasoline engine driven generators of the Homelite Corporation, Port Chester, N. Y., is described in a new bulletin. Generator sizes range from 500 watt to 5000 watt, AC or DC, 6 to 230 volt, 50 to 800 cycle. The weights of the complete units vary from 48 lb. for the smallest size to 142 lb. for the 5000 watt generator.

Crawler Track Pin Press

27. A new folder on its track pin press has been issued by Wm. Bros Boiler & Mfg. Co., Minneapolis, Minn. This is a massive tool designed and powered for the toughest jobs. The operating parts of the press are a gear pump, a piston valve, a cylinder of steel with ground and polished bore fitted with cast iron piston and piston rings.

Truck Bodies for Concrete

28. Bodies designed especially for handling concrete are the subject of a circular issued by Maxon Construction Co., Inc., Dayton, O. Illustrations of the uses of this body are given, together with drawings and dimension tabulations of the important features. The bodies, built in two sizes—2 cu. yd. and 4 cu. yd. rated concrete capacity—were designed by a well-known construction engineer.

**Want MORE
OUTPUT?
With LESS
LABOR?**

Solve Your DIGGING and MATERIAL HANDLING Jobs with 1 MAN and a **SAUERMAN** Scraper or Cableway

With one man at the controls, a Sauerman Power Scraper or Slack-line Cableway digs, hauls, and automatically dumps sand, gravel, earth or bulk material. Simple operation! Small expenditure of power! A Sauerman machine can be installed to reach across a pit, pond, river or stockpile, or up to the top of a hill. It moves material at high speed, anywhere within its wide radius. Flexible for any conditions.

Choice of handling capacities is available, from 10 to 600 cu. yds. per hour. Gas, electric or diesel power.

Send for useful information book based on data supplied by contractors, engineers, gravel producers, mine operators, etc. It's free.

SAUERMAN BROS., INC., 588 S. Clinton St., Chicago 7, Ill.



**Small Sauerman Scraper
Feeds Screening Plant**

Above picture shows a typical Sauerman job—1-Man Scraper drags gravel from hill at cost of few cents a yard.

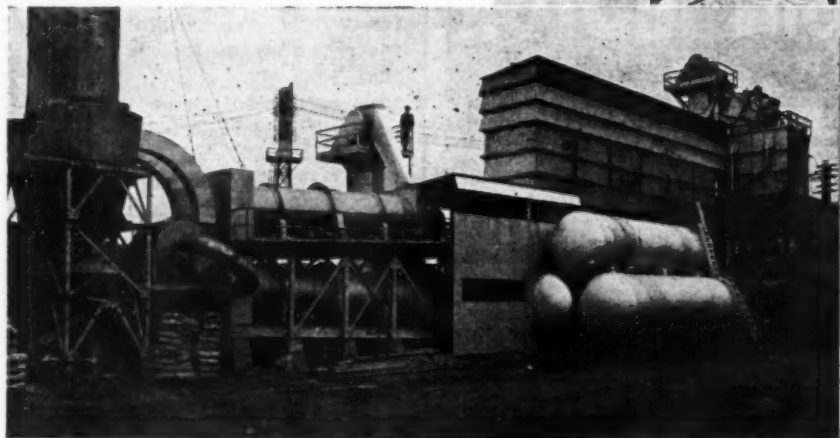
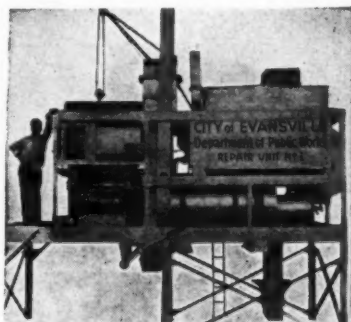
Locomotive Cranes

29. Standard and broad gauge Diesel and gasoline locomotive cranes are described in a 16-page catalog issued by Orton Crane & Shovel Co., Chicago, Ill. Construction and engineering details are liberally illustrated and explained. Charts give valuable data concerning clearance dimensions of Orton's standard gauge models, weights of re-handling and excavating clam-shell buckets loaded with various loose materials, and normal lifting capacities of all models at operating radius of 10 to 120 ft.

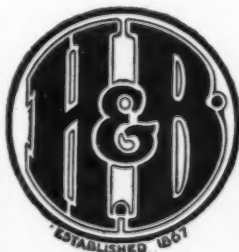
Joint and Crack-Sealing Machine

30. The "Blankner" pavement joint and crack-sealing machine is illustrated and described in a circular issued by Duggan's, Incorporated, 206 Auditorium Bldg., Cleveland, O. This machine consists of a two 12-in. wheel chassis on which is mounted a 25-gal. "flue type" bitumen kettle, with ring type burners for heating the bitumen. The heated material passes through a channel and is discharged into the joints or cracks by means of a needle type control valve 1½ in. above the pavement surface.

From the smallest
portable patch plants →
to the largest
stationary models ↘



H & B ASPHALT PLANTS ARE ENGINEERED AND BUILT TO GIVE TROUBLE-FREE, ECONOMICAL PERFORMANCE UNDER THE MOST SEVERE OPERATING CONDITIONS



Dependable performance—under a wide variety of operating conditions—is engineered and built into every Hetherington & Berner Asphalt Plant. As America's first builders of bituminous mixing machinery, Hetherington & Berner take pride in building equipment that will do a good job and prove a profitable investment for its owner. Every H. & B. plant is completely erected and checked at our factory before shipment.

Now that our war job is over, we are back to normal production of H. & B. plants of all types. Literature on H. & B. portable or stationary plants will be sent on request.

HETHERINGTON & BERNER INC. • 745 KENTUCKY AVE., INDIANAPOLIS 7, IND.

FOR BEST RESULTS — BATCH MIX • HOT MIX

WITH THE MANUFACTURERS & DISTRIBUTORS

Marchuk Promoted by Athey

A. T. Marchuk has been appointed production manager for Athey Products Corporation, Chicago, Ill. Mr. Marchuk joined the Athey organization in 1936, and has a wide background of experience with the company, having served in the shipping and receiving department, as traffic manager, as supervisor of the order department, in the sales department, and as controller of sales and production schedules. He played an important role in helping Athey meet the production demands of the Armed Forces.



A. T. Marchuk

Owens Returns to Osgood

R. C. Owens has returned to his position as secretary of The Osgood Co., and The General Excavator Co., both of Marion, O., after having served nearly three years with the U. S. Navy,



R. C. Owens

in which he held the rank of lieutenant. Mr. Owens will be actively interested in promoting the future development of both Osgood and General. Both companies have already announced several new and improved models which are already in production.

New Distributor for Buffalo-Springfield

The Tri-State Tractor Co., Washington at First St., Albany, Ga., has been appointed distributor in the southern half of Georgia for Buffalo-Springfield Roller Company, Springfield, Ohio. The company will handle a complete line of Buffalo-Springfield rollers.



*"Interior
Decorating"*

ISN'T OVERLOOKED,
EITHER, IN BUILDING

WISCONSIN
Air-Cooled
ENGINES

The interior of every Wisconsin Engine casting is sprayed with red sealer. This adds nothing to the "beauty" of the engine but it IS an important service and maintenance precaution — because it forever seals any loose particles from entering the oiling system and causing trouble. Small details such as this are important in safeguarding the engine user against equipment layups and expense which could otherwise result. You get dependable, heavy-duty serviceability when a Wisconsin Engine is on the job.

Most
H.P. per
pound



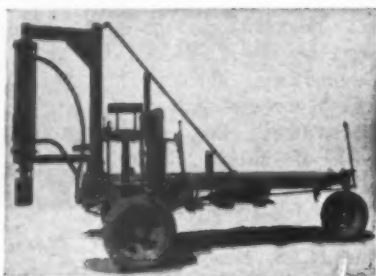
WISCONSIN MOTOR

Corporation

MILWAUKEE 14, WISCONSIN, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

RAPID!



Cuts concrete and cuts labor costs to 2 1/2 c per square yard. Applicable to floor work and different types of inside horizontal work.

Very efficient in maintenance work of highways.

Boom folds down and readily trailed by any light truck. Make your compressor treble its output by hooking it to this machine.

**Rapid Pavement
Breaker Co.**

1517 Santa Fe Ave.
Los Angeles 21, Calif.

LeTourneau Appointment

R. G. LeTourneau, Inc., has announced the appointment of Oscar W. Nelson as vice president and general manager of its Peoria plant. He was formerly general manager of the Beaver, Pa., plant, Propeller Division, Curtiss Wright Corp. He will have responsibility over all Peoria operations, his duties including those formerly handled by Denn M. Burgess, who recently resigned as executive vice president and director. Prior to his wartime association with Curtiss Wright, Nelson was vice president and general manager of the Muhler Co., Milwaukee, Wis., while handling other assignments as financial consultant, sales and production advisor. He has served as assistant to the president of the Voss Washing Machine Co., Davenport, Iowa, and also as plant manager of the Powers Accounting Machine Co., Kingston, Pa.



O. W. Nelson

Cummer Opens Branch Office

The F. D. Cummer & Son, Cleveland, O., manufacturer of asphalt plants and dryers, has opened a branch office at 101 Park Ave., New York City, to handle eastern sales and service work. The office will be under the management of M. B. Preeman, Secretary of the company.

P. W. Brown Joins Tyson

P. W. Brown, recently retired director of manufacturing for Wright Aeronautical Corporation, has been named a member of the board of directors and the executive committee to serve as director of production for Tyson Bearing Corporation, Massillon, O. Mr. Brown, in his position as top production man for Wright Aeronautical, supervised the entire war expansion program of that company. Mr. Brown, who is widely regarded as one of the outstanding production men in the country was throughout the war a member of the Automotive War Production Council and Chairman of the Manufacturing Coordinating Board of all companies manufacturing Wright products.



P. W. Brown

New Appointments by Worthington

P. A. Alers has been appointed manager of the El Paso, Texas, Office of Worthington Pump and Machinery Corporation, Harrison, N. J. He is a graduate of the School of Mining Engineering at the University of Wyoming, and has been connected with Worthington since 1933. Worthington Pump and Machinery Corporation also announces the appointment of Andrew S. Ormsby as director of industrial relations. He was formerly in charge of industrial relations of the Bendix Aviation Co.

Noble Back With Union Rope

Ray C. Noble has returned to his old duties as advertising manager for Union Wire Rope Corporation, Kansas City, Mo., after 3 years' service with U. S. Army. He had been with the corporation 5 years before entering the armed services.

WEEDS VANISH IF YOU USE 2-4D THIS SEASON

Tested and approved by leading agricultural colleges.

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TRADE MARK

*The Perfected
2-4D WEED KILLER
Will Do The Job!*

- COMPLETELY WATER SOLUBLE
 - DOES NOT DETERIORATE
- Write or wire dept. (s) now for quantity discounts!

HOWARD HANSON & CO.
Agricultural Chemicals and Hormones.
BELOIT, WISCONSIN

EMBURY Luck-E-Lite HIGHWAY TORCHES

Always on Guard!



Order through Your Jobber
EMBURY MFG. CO., WARSAW, N. Y.

New Distributor for Koehring

F. S. Ray Co., 7515 S. Main St., Houston, Tex., has been appointed distributor for Koehring, Kwik-Mix, Parsons and C. S. Johnson in the Houston area, the territory formerly served by the C. A. Koehring Co.



F. Wayne Ray and F. S. Ray

F. S. Ray, who is associated in the F. S. Ray Co. with his son, F. Wayne, is well known to contractors and construction equipment buyers throughout the country. He has been selling construction equipment for more than 20 years, having been associated with the Hug Co. for 14 years, with the Koehring Co. for 6 years.

MacFadyen Promoted by Timken

F. R. MacFadyen has been transferred from the Milwaukee office to the Canton Engineering Department of The Timken Roller Bearing Company as industrial engineer in which capacity he will act as assistant to S. M. Weckstein and Paul Haager, company officials announced.

Evans Products Division Renamed

The Heating and Ventilating Division of Evans Products Co., Detroit, Mich., has been renamed Thermo-Aire Division. The Thermo-Aire Division, which will continue to manufacture bus and truck heating and ventilating equipment, was renamed following development and improvement of the thermo-control fan, a thermostatically controlled variable pitch fan. A. R. Lintern, manager of the former Heating and Ventilating Division, continues as manager of the Thermo-Aire Division.

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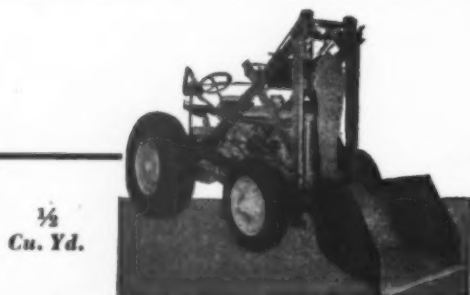
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New Wickwire Spencer Representative

Harry Bottomley has been appointed sales representative for Wickwire Spencer Steel in the southern Pennsylvania and Virginia territory. He replaces H. C. Stults, resigned. Mr. Bottomley, recently discharged from military service, was employed in the Hardware Products department before his induction in the army.

Matheny Heads New Caterpillar Division

C. A. Matheny, formerly a factory superintendent at Caterpillar Peoria plant and works manager of Caterpillar Military Engine Co., has been appointed head of the manufacturing development division, recently created by Caterpillar Tractor Co. Operating as a section of the general planning department, the new division will screen ideas for the improvement and development of manufacturing processes that originate in various departments throughout the plant, bringing promising ideas into current practice after discussion with the heads of interested departments and following necessary manufacturing research.



C. A. Matheny

George Dimond Now Distributor

George J. Dimond and John D. Colloton have organized the Dimond-Colloton Equipment Co., with temporary offices at 633 North Water St., Milwaukee 2, Wis. They will engage in the sales and service of construc-

tion and industrial equipment. Mr. Dimond has long been a prominent figure in the construction industry. Twenty-seven years ago he joined the Koehring Co., of Milwaukee, as a field service representative, rising through a steady succession of promotions to the post of sales manager, which position he held at the time of his resignation on May 31, 1944 to join the Insley Manufacturing Corp., of Indianapolis, Ind., as vice-president in charge of sales. On Sept. 30, 1945, Mr. Dimond resigned from Insley to join Mr. Colloton in the organization of their own company. Jack Colloton was born and raised in Wisconsin and after attending the University of Wisconsin he spent several years with the Milwaukee County Highway Department and has worked for several contractors in the state. He later joined the Standard Oil Company (Ind.), in the capacity of salesman. For the past four years he has been in business in Chicago as a construction equipment distributor.

Seifried Promoted by Ceco

John F. Seifried, for 26 years an employee of Ceco Steel Products Corporation, has been appointed Chicago district manager of the company. Entering the firm's employ in 1920



J. F. Seifried

as a member of the engineering department in the Chicago office, he became chief engineer in Chicago, in 1921. In 1922 he was appointed sales engineer and the following year he was promoted to assistant manager of the Chicago district. Edson O. Walker, vice president, continues general supervision of the Chicago district, including the Milwaukee, Detroit and Indianapolis offices.

New Sinclair Assignment for Zumbrook

Paul W. Zumbrook has been appointed manager of domestic lubricating oil sales for Sinclair Refining Co. In his new assignment, Mr. Zumbrook will coordinate the service and distribution activity of the Sinclair automotive and industrial lubrication staffs, working closely with equipment manufacturers for the development of lubricating oils. Mr. Zumbrook became associated with the Sinclair Refining Co. at the time of the establishment of the Chicago office in 1916.

South Bend GUTTER-SNIPE

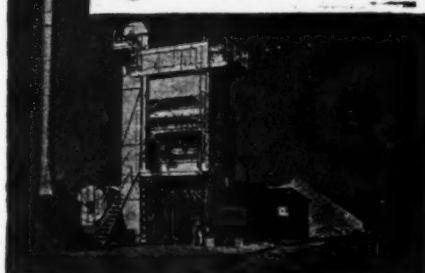
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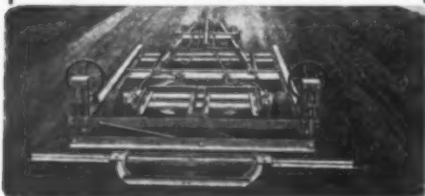
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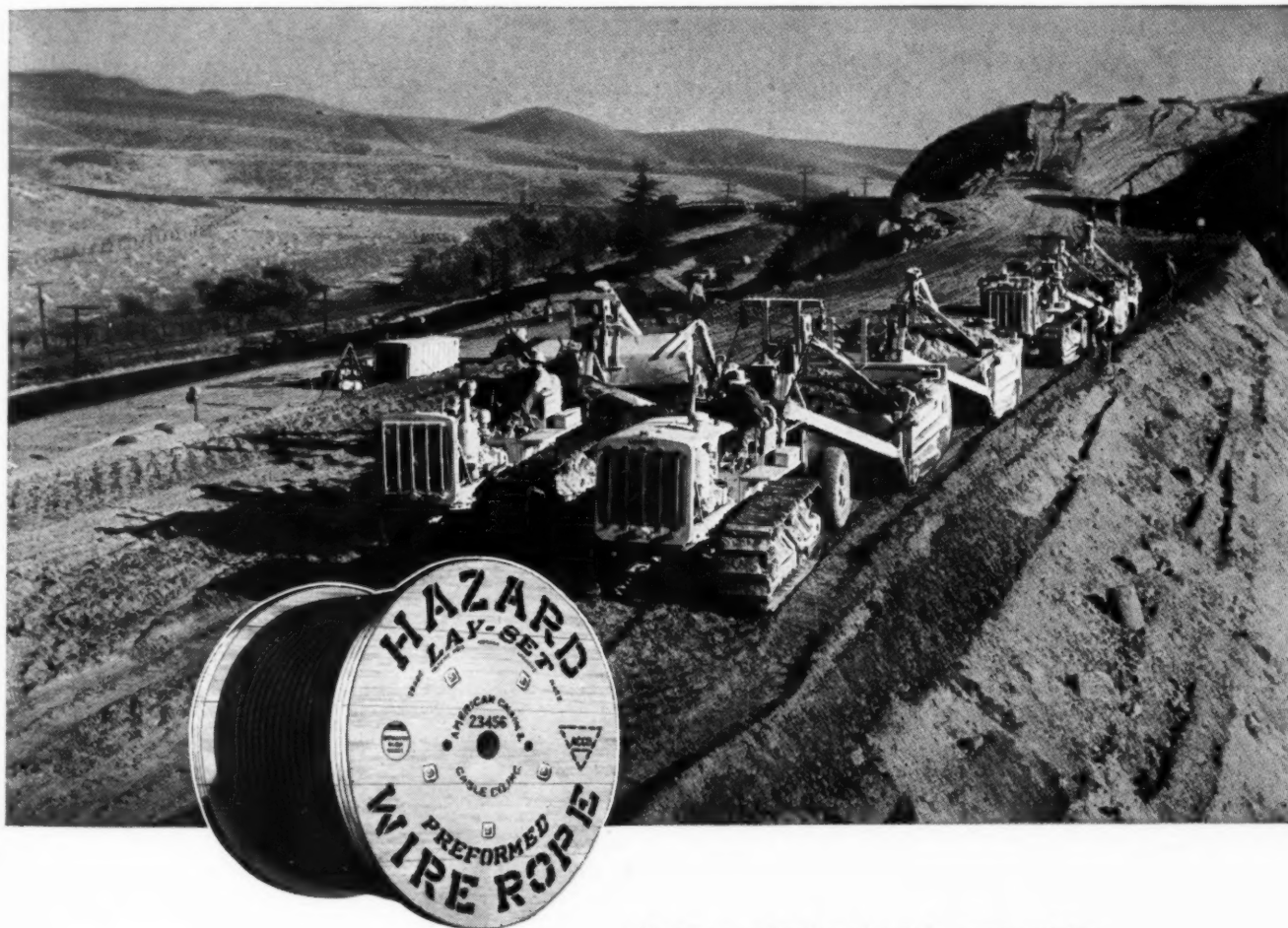
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